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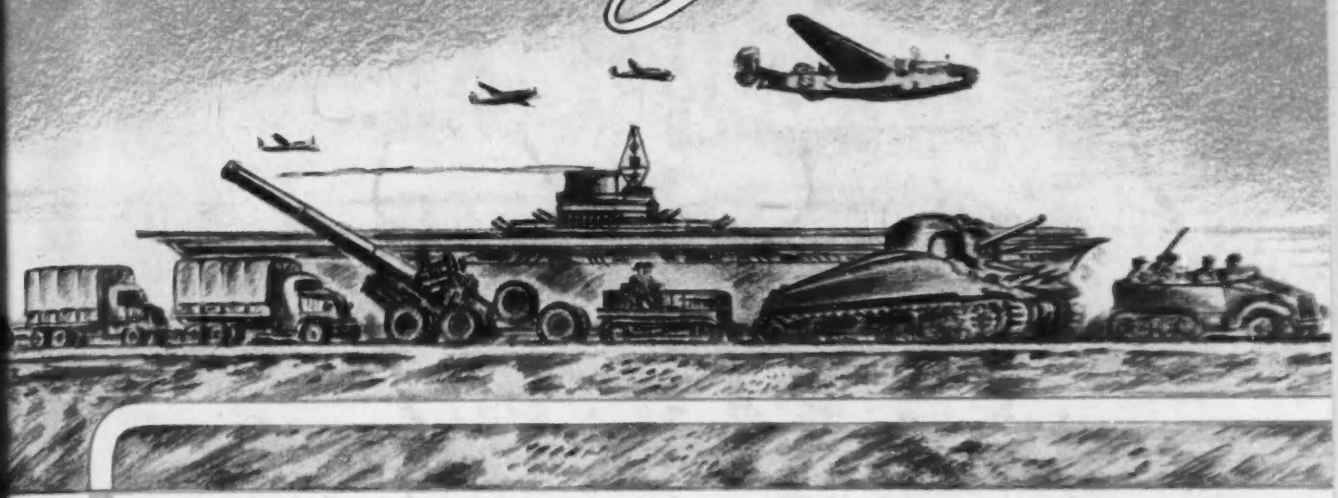
S·A·E Journal



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The Development of the Merlin Engine —J. E. Ellor

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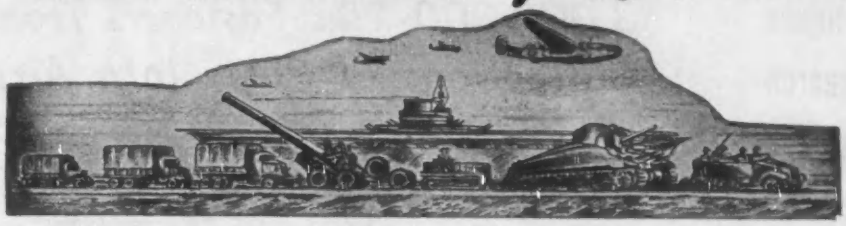
SAE JOURNAL *Pre-Prints*

THE SOCIETY OF AUTOMOTIVE ENGINEERS, INC. 29 W. 39TH ST., NEW YORK 18



News of the **September** *Issue*

By Norman G. Shidle

A Two-Way Street

THE term "free enterprise" has been shouted constantly and defined infrequently. Way back when the Blue Eagle flew, some business men cried freedom for themselves and restrictions for their competitors, asked government to remove competition from the competitive system which they praised so highly. The foggy idea that freedom for me and restriction for you can long exist did not die with NRA. It even enters some thinking about post-war reconversion.

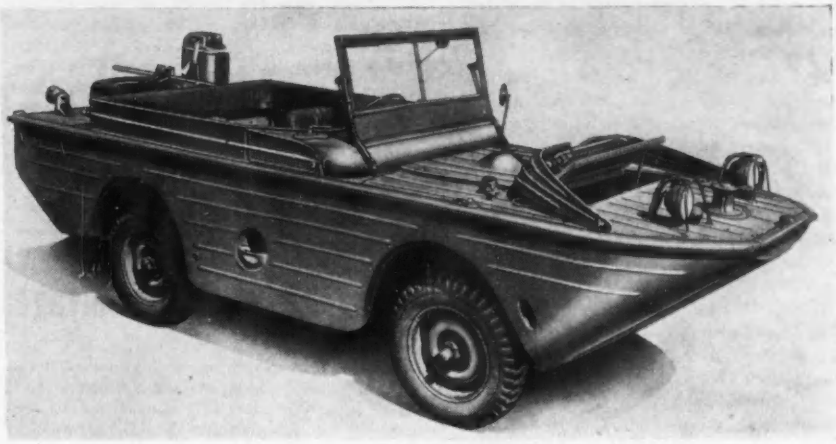
If business asks too much governmental protection against the hazards of the reconversion period, it will be gambling its future freedom of action. Better a competitor get a post-war start than that governmental limitations stop everybody. Temporary protection, too, easily can slide into permanent control.

Freedom of enterprise must mean freedom to fail as well as freedom to succeed, if it is to mean anything. It must mean freedom for a competitor to get a jump on us as well as freedom for us to get a jump on him some other time. It must mean freedom to be outsmarted as well as freedom to outsmart, belief in competition even when it hurts us. We can't have our freedom and be protected against our follies.

Freedom of enterprise means simply, freedom to be enterprising. To be enterprising is "to make a bold or hazardous attempt, to undertake with an adventurous spirit." Chance-taking is of the essence. It is for that chance-taking that the reward of profit comes to the free enterpriser. Protect him against risk and his privilege of profit eventually must be impaired.

The only security for business lies in insistence on the privilege of insecurity.

AMPHIBIAN "JEEP" SERVES INVASION FORCES



Sea-going "jeep," donning steel scow body, boathook, and running lights, and transferring power drive to propeller, operates afloat and ashore as agile reconnaissance and patrol vehicle for landing forces

Amphibian Vehicles Expedite Troop Landing Operations on Enemy Shore

COMMONLY overlooked developments in modern warfare are the comparative ease and speed with which invasion forces establish bridgeheads on enemy shores, and the tremendous scale upon which these particularly difficult and hazardous military operations are being accomplished.

Popular opinion is likely to ascribe successful landings chiefly to spectacular airplane umbrellas and naval bombardments which force enemy troops underground and pulverize coastal defenses. The fact remains that invading troops still must go ashore and consolidate the bridgehead. Aerial bombings and naval broadsides helpfully prepare the way, but a major factor for investing enemy coasts is the utilization of amphibian motor vehicles which simultaneously give the invasion forces extreme mobility and serve the cause of logistics.

Experience in Sicily, Italy, and France is demonstrating that troops and supplies can be landed upon invasion coasts more rapidly and effectively by amphibian trucks than would be possible if transports could moor at wharfs. For instance, amphibian trucks, or "ducks," can transfer troops and materiel from a ship off the coast to the shore or inland, wherever they may be needed, in one fast, continuous operation. Having the seaworthiness of self-propelled barges and the roadability of motor vehicles, the "ducks" give invasion forces, however deeply they penetrate, a round-trip sea-and-land transportation service which overcomes all the time-honored difficulties of maintaining assault forces in landing operations.

Story of this new development in warfare, as complete as military security permits, will be told in September *SAE Journal* by Col. E. S. Van Deusen, Ordnance Department. Col. Van Deusen will describe the development by American automotive engineers and the use by United Nations invasion forces both of the cargo-carrying "duck" and of its more agile cohort, the amphibian "jeep," which serves for reconnaissance and patrol.

Strain Gage Techniques In Structural Research Speed Airplane Designs

AERONAUTICAL engineers are pondering extensive structural flight research as a major factor for progress in aircraft design and construction. Opinion is expressed that unless and until it becomes possible to ascertain the nature and extent of strains and stresses developing during flight and maneuvers, progress must be hampered by uncertainty regardless of aerodynamics and materials testing.

This situation affects particularly the development of larger aircraft, such as the "Constellation" type, it will be pointed out by W. Lavern Howland, of Lockheed Aircraft Corp., in September *SAE Journal*. Mr. Howland will explain that many loads imposed on airplane structures never have been measured directly, and are known only by their overall effects. Even critical gust loads, which govern design strength of many parts, have been determined from calculations.

Mr. Howland will propose structural flight research through the use of wire resistance strain gages coupled with oscillographs. Easily mounted anywhere on the plane's structure, the gages will be said to make it possible to record and to study dynamic strains under conditions, such as gusts and landings, impossible in wind-tunnel research.

Pertinent problem capable of solution by strain gage technique, Mr. Howland will suggest, is that of determining loads on landing gears. These, infrequently used, representing a large proportion of structural weight, and blamed for many structural failures, are being designed by using arbitrary estimates of loads. Mr. Howland will describe how strain gage tests of the landing gear on the "Constellation" revealed loads and stresses never before given consideration.

3,000,000-Plus Fasteners Transform Collections of Parts into Airplane

LATEST contributions to the modern penchant for astronomical figures include the 3,000,000 rivets which, with spotwelds, adhesives, staples, bolts, screws, and a host of other fasteners, convert collections of parts into an airplane.

Rivets, riveting, and riveters account nearly for one-half the cost of airframe construction, as compared with 5% for spotwelding, 3% for bolting, and 2% for gas and arc welding.

These data are strictly wartime vintage. Making up joints was a simple problem with pre-war planes. Wooden structures were bolted, screwed, or glued with adhesives of a type used for 3500 years. Metal structures were riveted. While some experimentally minded builders may have toyed with spotwelding, by and large no questions were asked or raised.

World War II, with its demand for high-speed, large-volume production of planes capable of peak service, has made a decided difference in engineering attitude toward airplane fastenings. The change will be reported in September *SAE Journal* by E. S. Jenkins, of Airplane Division, Curtiss-Wright Corp.

Mr. Jenkins will say that the newly aroused curiosity is not merely intellectual. It has such basic causes as economics—and that 50% of the total cost of an all-metal airframe is made up of the costs of joining the bits and parts which comprise the assembled plane. He will add that curiosity has reached the point where laboratory tests of fastenings and joints are being made, with results which indicate there is more to making a joint than just inserting the fastenings.

Wartime Methods Salvage Discarded Engine Valves

WARTIME allocation of high alloy steels to essential war production probably had few more critical results than curtailing the supply of replacement valves for motor-vehicle engines.

Overnight the economic value of valves in repair shop scrap bins took an upturn. Discarded valves took on a patina of indispensability which no amount of rust or grime could conceal. The cost of reclaiming them was high, but the question was one of valves, not costs. No other valves were available.

Developing and disseminating data on valve reclamation was one of the wartime jobs undertaken by Engine Valve Group of the Reclamation of Parts, Subcommittee of the SAE-Ordnance Vehicle Maintenance Committee. It was in the nature of a first-aid operation for fleet managers in distress, and it served to keep many a motor vehicle rolling.

Detailed account of this wartime enterprise will be presented in September *SAE Journal* by Norman Hoertz, of Thompson Products, Inc. Mr. Hoertz is chairman of the committee, which collected 600 valves at random from the scrap barrels of fleet operators and service stations, and then went about the essential business of finding ways and means of putting the discarded parts back to work.

Restrictive Laws Handicap Progress In Designing Post-War Motor Trucks

MOTOR truck designers and manufacturers are expressing an understandable hope that post-war progress in highway development will be accompanied by realistic amendment of state size and weight laws governing commercial vehicles to increase widths across the tires by six inches. Currently a 96-in. width is legal maximum except in Connecticut and Rhode Island, where the desired 102 in. is permitted.

The importance of six inches in width to post-war truck design will be explained in September *SAE Journal* by B. B. Bachman, vice-president, The Autocar Co., from the point of view of automotive engineers who need that half-foot to improve braking and springing.

Mr. Bachman will point out that no increase is sought in truck body width, which, limiting highway vision and vehicle clearance, chiefly is the cause of chassis width regulations framed in the days of solid tires. General use of increasingly wider pneumatic tires on trucks appears to have cramped not only the designers' style, but to have created a problem as to where to install brakes, springs, and other essentials in gradually diminishing space.

By making the legal width 102 in. overall across the tires, Mr. Bachman will explain, it would be possible desirably to widen the rim bases of truck tires, to install longer and wider springs, and to improve crowded brake installations. These suggested changes will be characterized as improvements contributing directly to operating safety, tire life, and vehicle stability.

Cooling Fan Improvement Boosting Performance of Modern Aircraft Engines

AMONG the infinitely numerous and complicated factors which affect the operating efficiency of aircraft engines are cooling fans.

The job of cooling an engine with a fan seems to have an illusory simplicity. At least five years of research have been devoted to the effort, yet engineers insist the operation still is only marginal and that modern fan design and construction practices represent merely an expensive compromise.

Apparently it costs horsepower to get cooling air to the engine, and additional horsepower to get rid of it. Engineers estimate the cost on the order of 400 to 500 thrust horsepower per nacelle, depending upon engine size and altitude. They indicate they would like to eliminate the fan, but scooping air through cowls is described as hopelessly inefficient and five times as costly as fan cooling.

Interesting account of this engineering dilemma will be presented in September *SAE Journal* by Kenneth Campbell, of Wright Aeronautical Corp.

S·A·E Journal

Published Monthly by The Society of Automotive Engineers, Inc.

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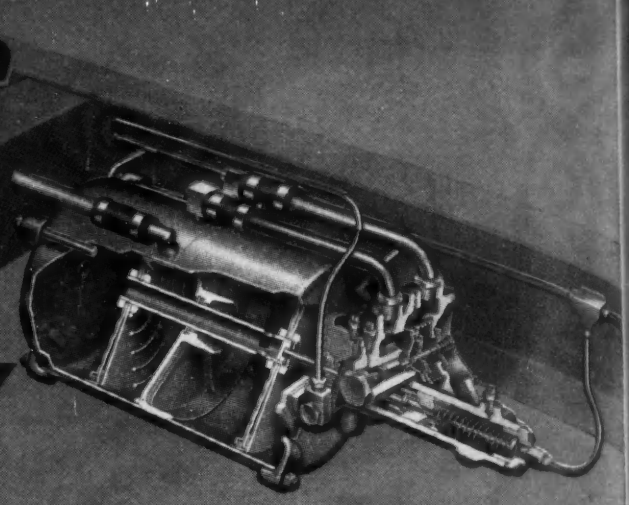
Hydrovac POWER BRAKING BY Bendix



For War-Essential Trucks, Tractors and Buses

Here's a quick picture of the most thoroughly proved new product ever offered the automotive field—the outstandingly simple, sturdy and efficient Hydrovac power braking unit, designed and built by Bendix—*brake headquarters for more than thirty years.*

In design, the Hydrovac power braking unit is small, compact, and completely enclosed against dirt and water. *In installation,* the unit is simplicity itself. It can be located any place on the chassis as the mounting brackets are never required to withstand loads due to reaction from brake applying forces. There are no external levers, and only three tubing connections are needed. *No adjustment* is necessary either at installation or later in service.

That's good news, and here's more: Hydrovac power braking is available *right now* to qualified wartime users! Check over the list of important advantages at the right, judge its exceptional worth for yourself—then see your Bendix B-K dealer, or write the factory direct.

- ✓ A normal "feel" or reaction on the brake pedal allows the driver to sense the exact degree of brake application or release.
- ✓ Instantaneous brake action is accurately graduated in response to the exact degree of pedal operation by the driver.
- ✓ No external levers, links or other mechanical moving parts.
- ✓ All working parts are within the Hydrovac braking unit, where they are protected from outside dirt and water.
- ✓ No reaction loads on mounting brackets—all stresses are taken internally.
- ✓ Extremely easy to install; may be located at the most convenient place on the vehicle chassis.
- ✓ The controlling force from the brake pedal is automatically added to the force of the power cylinder.
- ✓ Provisions for trailer connections allow controlling trailer brakes in correct balance with tractor brakes.

"HYDROVAC" AND "BENDIX" ARE TRADE-MARKS OF BENDIX AVIATION CORPORATION

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FUTURE HORIZONS in DIESEL ENGINE DESIGN

by
CAPT. LISLE F. SMALL,
Navy Department
Bureau of Ships

THE U. S. Navy clearly defined its position with respect to internal combustion engines when it authorized diesel power boats for all new cruisers and destroyers of the 1933 construction program. Subsequently, the production of gasoline engines for power boats was stopped completely at the Norfolk Navy Yard and since then, over 5000 diesel engines have been built there for standard BuShip boats alone, with several thousand others procured from a private builder. The war has justified fully the Navy's choice of the diesel engine for its unsurpassed fuel economy and absence of fire hazard. Many types of diesel engines have been developed since to propel and power a variety of naval vessels and at least one manufacturer completed over 20,000 engines of the same size and type during 1943.

The Navy believes wholeheartedly in diesel engines and I am proud to announce that as of October, 1943, the combined horsepower of diesel engines being installed in Naval craft exceeded that of the steam turbines for the first time in the history of your Navy. Considering the fact that every time a capital ship or aircraft carrier is commissioned over 200,000 and with each destroyer over 60,000 hp in steam turbine output is added, while diesel engines power ships of less than 12,000 hp, this interchange in rank and importance between diesel and steam is a highly significant milestone.

■ The Diesel and Combat Service

What is it then that keeps the diesel engine from use in combatant surface ships of the Navy and how could such a goal be achieved? The answer to this question, based on the Navy's extensive experience, may be helpful to all engineers interested in future development of the engine.

The Navy appreciates the instant readiness of the diesel engine to take full load, for it means quick getaway for a ship at anchor and ability to increase speed at will while under way should occasion demand it. Such disasters as Oran, Taranto and our own Pearl Harbor would have been greatly lessened had the ships been propelled by diesel engines. On the other hand, the size of the propelling plants, ranging from 60,000 to over 200,000 hp, is manifestly out of the range of existing designs of diesel engines. What is needed, therefore, are units of much higher output, of lighter weight, smaller bulk and *much* simpler construction.

■ Navy Favors Turbine Blade

Every engineer understands that every individual turbine blade is a small, but, nevertheless, complete steam engine unto itself for converting the heat energy of steam into the mechanical energy of the rotating turbine shaft. Yet, it is simplicity itself – a cantilever beam of mathematically determinable cross-sections with an elaborately shaped root for fastening to the turbine disc, but a single place nevertheless. Is it a wonder then that as many as 250,000 blades per ship had been installed in some Naval vessels without hesitation?

Much has been done already to widen the scope of usefulness of the diesel engine in the Navy. Representatives of the Bureau of Ships on several recent occasions have traced its development since the last war, when 29 cu in. of piston displacement were required for each horsepower output, to our latest types requiring only 2½ cu in. The reduction of weight has been from 60 lb per hp to 4½ lb with consequent shrinkage in bulk. The development of welded steel construction and the production of many ingenious arrangements of cylinders have also been reported on. Such current problems as the need for simplified treatment of torsional vibration and for development of

uniform and objectively conceived standards of acceptable porosity in the chrome-plating of cylinder liners have been brought to this society, and I am happy to report your wholehearted cooperation through the medium of the War Engineering Board. Two committees of outstanding authorities in the field have been organized and practical results doubtless will be forthcoming very soon.

> ***"This war will be known to history for its amphibious operations and internal combustion engines which have been built already and will continue to be built in ever increasing numbers. They provide that flexibility and radius at sea, through the air and over the ground, which will eventually overwhelm our enemies."***

The performance of the diesel engines in the Navy is most gratifying. No engineer will construe this to mean that we have no troubles, for that is impossible as long as human beings build the engines. However, for every engine which gave us trouble, we have scores and even hundreds of its duplicates, in some cases, that operated trouble free for thousands of hours. It is true that some engine types are more foolproof in operation than others and some designs will stand more abuse and neglect, such as are inevitable in the grim business of war and result from the natural impulse to fight for survival. But I repeat that on the whole, the diesel engines in the U. S. Navy have been performing satisfactorily and have earned the confidence of all operating personnel. Hence, anything that I will say from now on must *not* be construed as a criticism of the equipment with which the diesel industry has provided us, but as a sincere attempt to define the road of highest promise into the future.

■ Two-Cycle Engine Preferred

To begin with, I see no room in the future for the four-cycle naturally aspirated engine. During two strokes of the four-stroke cycle, the cylinder pressures are substantially atmospheric – hence, one-half of the weight of this engine must be considered as the weight of its charging equipment. In a two-cycle engine, the weight of its scavenging blower is manifestly very much lighter than the weight of the engine proper and accounts for the weight and bulk advantage of the two-cycle engine. We can all agree that the four-cycle naturally aspirated engine is a marvel of simplicity of construction, its pistons and valves are free from heat troubles and it will, no doubt, survive for long in our automobiles, but we cannot afford such a luxury in a Naval vessel where weight and space are at a premium and badly needed for the primary purpose of a fighting ship. The use of a high-speed blower of light and simple construction to supercharge the four-cycle engine appears inevitable to me for future designs.

Economic necessity will force us to take advantage of every metallurgical development for parts exposed to heat in order to increase the mep and horsepower output of the engine and thereby reduce its weight and bulk. This will result in higher pressure within the cylinder at the moment exhaust begins and consequently in greater losses to the exhaust gases, with higher fuel consumption and lower efficiency unless we utilize the energy in the exhaust gases. Buchi pioneered in this field and achieved roughly a 50% increase in the horsepower out of a four-cycle engine by expanding its exhaust gases in a turbine driving a centrifugal blower, which thereby supplied over 50% more air to the engine for combustion of increased amounts of fuel. Furthermore, Buchi turbocharged engines have lower exhaust temperatures and, therefore, greater margin of reliability for pistons and valves. The fuel consumption of these engines is greatly improved also. Buchi's success rests upon his patented grouping of cylinders exhausting into one manifold to secure non-interference. However, his own published tests show that greater energy will become available to the turbine if every cylinder has its own exhaust duct to the turbine. This arrangement provides higher supercharging pressure with consequent further increase in engine output. Improved turbocharging by the use of individual exhaust passages appears to be the next step which builders of four-cycle engines should adopt if this type of engine is to survive the competition of the post-war period.

■ Opposed-Piston Engine

Considerable numbers of several different types of high-speed two-cycle engines are in service in the U. S. Navy. While all of them perform with varying degrees of success, I have no hesitation to make the statement that the future belongs to unidirectional scavenging types and I will even go one step farther and say very much more effort should be concentrated on the development of the opposed-piston type of engine, where each of the two pistons is used to control a row of ports – scavenging and exhaust. The compelling reason for making this bold statement concerns the simplicity of construction of this type of engine and the greatly reduced number of parts, with the accompanying reduction in noise due to non-existence of poppet valves. In my opinion, the poppet valve must be abandoned if we are to have engines suitable for propulsion of combatant surface ships. The poppet valve is the principal barrier to higher engine speeds because it is the main source of noise and vibration and the bottleneck in the path of escaping gases. Valves, seats, springs, rockers, camshaft and its drive – all of these will vanish together to the profound satisfaction of the operating personnel.

All of this is really not a very original deduction on my part. As time goes on, many more engineers learn to appreciate the advantages offered by the opposed-piston design and several different variations have been developed in addition to the original design with a single crankshaft and siderods. Sulzer Brothers has recently adopted the two-crankshaft opposed-piston construction, developed by Junkers for aircraft engines. In addition, Sulzer Brothers have been building a horizontal rocking-lever type of opposed-piston engine for the last few years. Burmeister & Wain, as well as Harland & Wolf, have finally adapted the side-rod opposed-piston design to their double-acting two-cycle engine after trying several designs with poppet valves for exhaust. Finally, several different designs of crankless engines, now in the course of development, also use the basic opposed-piston feature and there is no reason to assume that additional and better adaptations are impossible.

With high capacity ports for both intake and exhaust,

each cylinder becomes a simple pulsating combustion chamber scavenged and recharged after each charge of fuel is burned, with compression used to produce auto-ignition temperatures and expansion of gases to yield power. The expanded exhaust gases mixed with the surplus scavenging air will constitute the new low-pressure energy medium to be expanded finally in a turbine of much higher rotative speed and, therefore, of lighter construction with consequent lowering of weight per horsepower for the complete unit.

It may appear to you that we have arrived at something all practical men have frowned upon ever since Diesel himself failed in the attempt to make it practical, namely, compounding, which has fascinated also such distinguished engineers as Junkers, Sperry and George Curtis of the turbine fame. But be it as it may and whatever the label of designation, the time, in my opinion, has arrived when practical men responsible for powering of ships must prod the industry into the next step of development because the successful performance of the elements necessary for the next type of internal combustion prime mover warrants it. We must move forward.

■ Turbine Plays Important Part

Now – shall we head immediately to the gas turbine as the sole generator of torque or is there some intermediate approach? I do not believe it is important that this question be answered in either the affirmative or negative at this time. Suffice it to say that the turbine must be invited to play as big a role as it is capable of doing successfully. Its ability to utilize exhaust gases of four-cycle engines effectively has been demonstrated. The decision as to the line of demarkation between the engine and the turbine as well as to the level of pressure and temperature of the gases for the turbine must be made in the near future. It is safe to state that initially we can assign the turbine the same task it is so admirably performing for the four-cycle engine, namely, that of providing scavenging and charging air for the two-cycle engine. Why was it not done long ago, you may ask. The principal reason probably lies in the fact that the exhaust gases of the normal two-cycle engine carry a considerable amount of scavenging air and are, therefore, of much lower temperature. Furthermore, the pressure at the opening of the exhaust ports is usually lower and the exhaust header of the engine is normally of much greater volume in order to reduce back pressure or resistance to scavenging. These conditions will be changed in the improved two-cycle engine of the future.

Now that the announcement of regular production of jet-propelled planes is made, it may have occurred to you that our aircraft friends have stolen a march on us, who are confined to the sea level regions, as far as the gas turbine is concerned. I do not think that is necessarily so – they merely took advantage of the simple but very important phenomenon that atmospheric pressure decreases with distance from sea level, something they have been successfully utilizing in turbocharging aircraft engines for many years. This gives them lower back-pressure and greater pressure drop for operation of their gas turbines the higher they rise – therein may lie the solution of stratosphere flying at really high speeds. I have already referred to the ingenious device by which Buchi achieved the same effect by cylinder grouping and suggested that we improve it further by providing each cylinder with its own exhaust passage. When this suggestion is carried out for the two-cycle opposed-piston engine and the gas pressure at opening of exhaust ports is raised, there will be ample energy in the "ballistic" or Kadenacy effect of the escaping gases to drive a scavenging blower and thereby achieve a similar pressure drop as in aircraft. Eventually, this blower may be transformed into a compressor of higher pressure and the engine, turbine and compressor gears into one common unit as Sulzer Brothers is doing on their new engine. By going one more step, the engine output may be reduced to the requirements of the compressor and these two form a new type of unit – a power gas generator providing its exhaust gases mixed with surplus air for the turbine driving the propeller of a ship either through gears or through electric transmission. A number of experimental installations of this type for ship propulsion were made before the war by Gotaverken in Sweden.

The final and most attractive step in these series of developments is the elimination of the crank mechanism in the engine-compressor or gas generator unit. The resulting free-piston type of gas generator is being developed by Pescara interests in France and England. This last development will require considerable time and effort before a thoroughly practical means of ship propulsion will emerge. However, the Bureau is actively supporting it in this country, as well as the parallel of development of continuous-combustion type, where one turbine is driving an axial compressor and another one the useful load. Which of the two will succeed first or whether both methods will yield attractive solutions and be co-existent in the future is not given to us to know positively at this time but there is a lot of metallurgical progress needed before the fuel economy of the continuous-combustion type can be made good enough to consider seriously its adaptation in a Naval vessel, where economy of fuel is of greater importance than the reduced first cost.

SAE Coming Events

National Meetings

West Coast T&M, *Aug. 24-25, Multnomah Hotel, Portland*

Tractor, *Sept. 13-15, Schroeder Hotel, Milwaukee*

Aeronautic & Engineering Display, *Oct. 5-7, Biltmore Hotel, Los Angeles*

Fuels & Lubricants, *Nov. 9-10, Mayo Hotel, Tulsa*

Air Cargo, *Dec. 4-6, Knickerbocker Hotel, Chicago*

Annual Meeting & Engineering Display, *Jan. 8-12, 1945, Book-Cadillac Hotel, Detroit*

Aeronautic, *April 4-6, 1945, Hotel New Yorker, New York*

Diesel F & L, *May 16-17, 1945, Carter Hotel, Cleveland*

War Materiel, *June 4-6, 1945, Book-Cadillac Hotel, Detroit*

INDUSTRIAL CAISSONS KEEP WA

SAE T&M Meeting Rev

Licking Wartime Ma

AMERICAN automotive design and fleet maintenance engineers are settled to the grim task of keeping war supplies and materials moving by highway.

Replacement of commercial vehicles is badly needed. There is an acute shortage of operating and servicing manpower. Spare parts bins are getting bare of everything except ingenuity.

Yet the industrial caissons keep rolling, recording unequalled mileages, providing unparalleled experience, and proving that wartime automotive equipment, rugged beyond question, is the prototype of post-war vehicles capable of creating new conceptions of highway transport service.

These were inescapable conclusions of the SAE National Transportation & Maintenance Meeting, held June 28 and 29 in Philadelphia's Bellevue-Stratford, and attended by operating managers of America's great truck fleets, other automotive and maintenance engineers, representatives of equipment manufacturers, and Government and military agencies. Again the role of SAE in bringing designers and users together on specific problems dramatized one of America's most effective weapons of war.

Sponsored by SAE Transportation & Maintenance Engineering Activity, directed by SAE Vice-President Ellis W. Templin, with the SAE Philadelphia Section cooperating, the meeting served further to disseminate pertinent wartime engineering information. Detailed arrangements were made by the General Committee, with Gavin W. Laurie, as chairman, assisted by E. P. Gohn, E. N. Hatch, Mr. Templin and G. Ralph Strohl. Mr Gohn served as chairman of the Philadelphia Section Reception Committee, which included Messrs. Laurie, Strohl, C. M. Billings, G. D. Branaman, F. C. Burk, Linn Edsall, C. W. Engle, P. E. Friend, J. C. Geniesse, J. Higgins, C. H. Miller, J. R. Sabina, William Schwarze, Jr., and O. M. Thornton.

Technical discussions struck at the heart of wartime maintenance problems and produced sound reasons for believing that:

- Returning war veterans may relieve the manpower shortage even sooner than was hoped.
- Post-war commercial vehicles will benefit from wartime operating experiences and progress in metallurgy, fuels, tires, and other key factors.
- Synthetic tires, good enough with reasonable care to maintain highway transportation for the duration, within short years may become superior to any tires so far developed.
- Cooling systems may undergo stage improvement to the point where they will function with complete satisfaction and afford not only good service but complete ease of maintenance.
- Engine sludge formation, either hot or cold, can be controlled.
- Application of electronic principles to tire vulcanization suggests such satisfactory results as to presage the 100,000-mile tire.

Capacity Crowd Hears Col. Andrews

More than 600 engineers attended the sessions despite intense heat. A capacity crowd at the dinner paid close attention to a review of re-employment plans for war veterans, and then, by rising vote, expressed to Col. John M. Andrews, of National Selective Service System, their appreciation of his practical exposition of methods whereby employment of veterans could relieve manpower shortage in highway transportation and other industrial activities.

Veterans of World War II, many of them college trained, a majority already having high school education, will be demobilized in orderly progression, Col. Andrews explained. Wounded men will be aided by advisement, training, and placement, as well as by vocational rehabilitation, so that they will be trained workers even before taking jobs.

While the re-employment problem was characterized as tremendous because of the huge American Army, Col. Andrews said that a substantial proportion of veterans undoubtedly will return to colleges and trade schools for periods of one to four years. Some 3,000,000 never have been employed, he added, and these, with the wounded, will receive training to fit them for productive and remunerative jobs.

Col. Andrews revealed that industry will be able to draw upon a talented group for post-war employment. Some 14% have had college training. More than 50% have had high school education. Only one-third will be as being below grade school level, as contrasted with 80% in the last war.

Even the disabled men will make satisfactory workers, he added, for the rehabilitation program calls for consideration of previous education, training, skills, aptitudes, and interests.

James Stresses War Job

"Most workers drift into employment," he said, "while rehabilitated workers, because of their guidance and training, will enter employment for which they are particularly well prepared. In other words, the disabled man, after training, will be a hand-picked and hand-fashioned worker for the job."

SAE President William S. James told the dinner guests that the cooperative T&M job of keeping motor vehicles of the armed forces and of industry rolling despite wartime shortages of time, replacements, materials, parts, and manpower is so successful as to be its own eulogy.

EP WAR GOODS ROLLING!

ing Reveals Engineers

ne Maintenance Job

Gavin W. Laurie, general chairman of the meeting (left), and SAE Vice-President Ellis W. Templin (right), talk with Col. John N. Andrews, dinner speaker (center)

(Left to right) Philadelphia Section Chairman F. C. Burk; Lt. Col. H. O. Mathews, toastmaster at the dinner; and SAE President W. S. James

Automotive engineers have the moral satisfaction which comes from a good job well done, he added, and "fortunately also their cooperative war work is developing a mutual understanding of automotive service requirements which augurs well for the future."

Asserting that T&M, by pooling automotive knowledge and experience on a nation-wide basis, is producing effective results, SAE President James recommended that its work be continued in peace.

"We have a common cause today," he declared. "We shall have common problems tomorrow. Accessibility, transmission design, cylinder liners, driver comfort and vision, brakes, electrical equipment, and wiring – these among many common problems – will go on and on. They will be solved only to be exceeded by others. We should exercise the good sense to utilize the power of cooperation in solving them."

Chairman Franklin C. Burk, of SAE Philadelphia Section, introduced as toastmaster Lt.-Col. Harry O. Mathews.

Post-War Maintenance

Post-war horizons limned technical papers on wartime maintenance, as if indicative of a confirmed belief that present commercial automotive equipment, good as it is proving itself to be, is merely transitional. It became increasingly apparent at the four well-attended sessions of the T&M meeting that while pressing wartime work may have prevented crystallization of thinking and decision on policies governing the design and development of post-war trucks, nevertheless broad engineering cerebration definitely is under way. The requirements of post-war truck operators, as stated at this and earlier post-war meetings, for instance, are receiving serious consideration.

Stated requirements of truck operators, however important, were characterized as comprising only one of four basic factors controlling post-war development, the others being legal limitations, sales appeal, and driver acceptance. It was explained that operators' demands for ease of maintenance, for instance, must be tempered by the fact that commercial vehicles are designed and built primarily to run, not to repair. On the other hand, it was explained that improvements in cooling system design and construction requested by operators largely could be met. Some, such as maintenance of engine operating temperature with the least practicable variation for all operating conditions, call for the use of complicated mechanisms which make servicing and maintenance more difficult. Engineering conflicts were said to require engineering compromises, with steam cooling a case in point.

Electrical equipment satisfactory for rugged service in commercial motor vehicles was described as being in conflict with economics, since the low volume required for the truck market tends to make for high unit prices. Similarly it was said that while truck design for unit replacements might contribute to ease of removal and maintenance, it also adds complications, weight, wearing parts, and costs which could be avoided by capitalizing upon better knowledge and improvements in materials to produce vehicles and units having longer life, greater simplicity, less weight, and lower cost.

Customer comments on truck cabs were accepted as outlining a problem with which truck manufacturers are sympathetic and about which something can be done by the design engineer.

Expressed ideas about post-war trucks presented an interesting picture of possibilities rather than probabilities, and of trends rather than design details. In fact, there was little indication that any sharp and sudden change could be expected in truck design immediately after the war. There were suggestions, supported by engineers' evidence, that, instead, post-war trucks would be featured by improvements upon and perfections of present design details rather than innovations.

Post-war truck design trends, stated concisely, were visioned about as follows:

Lt.-Col. C. W. Vogt, Chief, Technical Staff for Supply, Transportation Corps, War Department (right) explains new tire vulcanizing unit to Jean Y. Ray, chairman, SAE T&M War Advisory Committee

Performance: More durable and powerful trucks, with horsepower gains converted to higher sustained speeds or greater loads.

Engines: Development of present types to obtain maximum benefits of increased horsepower and speed, possibly on the order of 130 bmep and 3000 rpm maximum, within the limits of materials and design. Growing interest in overhead valves. Divided opinions on the use of cylinder liners.

Transmissions: This major technical problem of the truck of tomorrow may be detoured by use of fluid couplings and torque converters if continued experience and further development make them practicable. Study being made of gear box ratios with regard to performance characteristics which can be produced by more powerful engines.

Rear axles: Trend toward fast axle ratios and single reduction through hypoid gears, provided added costs can be justified by economies.

Brakes: Power application coming into more general use. Definite relationship between braking and steering, and resulting hazards, recognized. Removal of brakes from wheels regarded as overloading drive lines, although current development of auxiliary power absorbing unit for controlling speed downhill might change this picture.

Suspension: Unsuitable characteristics of leaf springs recognized, as is also extreme variation in truck loads. Studies of and experiments with torsion bars indicate progress. Possibility of independent wheel springing is not overlooked, but is attended by major design and maintenance difficulties.

Cab location: Conventional and C.O.E. probably will continue in use, each as it more satisfactorily meets specific operating requirements.

Special types: Pre-war developments of special light-duty trucks for specific industrial uses probably will feel the impetus of post-war competition.

Legal limitations: Definite barriers to truck design progress, but correction of conflicts between non-uniform state regulations as war measure offers hope that uniform statutes satisfactory to all states can be developed.

Post-war possibilities for truck design featured also discussion of synthetic tires, which revealed expectations that a few short years of trying would lead to production of tires having even better qualities and characteristics than those made of natural rubber. To superior quality were added such possibilities as adequate quantities and reasonable prices.

The synthetic tire picture was made brighter by revelation that synthetic rubber production is running ahead of estimates—66,000 long tons in April, with 87,000 long tons per month expected in the final quarter of 1944. Crude natural rubber was said to be coming into the country, approximately one-quarter of it from American-developed plantations in Liberia, but not in sufficient quantities to offset the serious inroads made upon stockpiles by American and Canadian military requirements.

Increasing production of synthetic tires was described as forcing the use of rayon cords instead of cotton. Rayon cord production was estimated at close to 16,000,000 lb per month by the end of 1944, and as reaching 20,000,000 lb per month sometime in 1945. Pearl Harbor period output was reported as 2,000,000 lb monthly.

Aside from increased availability, rayon cord was said to be superior to cotton, whether measured pound for pound, gage for gage for strength, or by freedom from premature body failures and impact breaks, or by reduced overall cost per mile, or by conservation of rubber.

Wartime use of synthetic tires on commercial vehicles was described as satisfactory only if the tire receives proper care and maintenance. Overloading, improper inflation, high speeds, and hot weather were listed as the chief foes of synthetic tires and fleet owners, and operators were told they must not only be realistic, but should favor and coddle synthetics.

Overloading was said to cause premature body failures and separation of plies in tires, flabbiness in tubes. Operators were advised, for safety and long wear to calculate the load on each individual tire and to distribute the load of the vehicle equally between the wheels. Calculating the average load of the whole vehicle, or the load on either end, was characterized as unsafe practice.

Under- and over-inflation were said to be

SESSION CHAIRMEN

POST-WAR TRUCKS

G. W. LAURIE,
Atlantic Refining Co.

SLUDGE

E. W. TEMPLIN,
Los Angeles Bureau of Power & Light

SESSION CHAIRMEN

COOLING

E. N. HATCH,
New York City Board of Transportation

TIRES

A. M. WOLF,
Automotive Consultant

equally harmful, and pressures in synthetic tires must be checked at least twice a week. Vehicle operating speeds and atmospheric temperatures were reported to be so critical that operating schedules must be calculated both by clock and thermometer.

It was recommended that at atmospheric temperatures below 40F, cruising speeds should be set at 40 mph, maximum speeds for short distances limited to 50 mph. At temperatures of 40F to 80F, cruising speeds advisedly are held to 35 mph, short spurts to 45 mph. When the thermometer goes above 80F, cruising must be done at not more than 30 mph, spurts held down to 40 mph.

So much maintenance is required to protect and to perpetuate synthetic tire equipment that fleet operators were advised to employ for each shop a tire maintenance man who would take a personal interest in tire life, make sure the synthetics were retreaded at the proper time, and otherwise give the tires individual care.

Increased synthetic tire production capacities were described as assuring reduced manufacturing costs and prices – possibly within a period of two to four years – if accompanied by a reduction in materials costs. There were indications that in the case of the post-war tire first cost is less important as an economic factor than overall cost based upon miles of service vastly extended by the use of a new tire-vulcanizing device applying principles of electronics.

The device, consisting of a press ram equipped with an electrode coupled to a high-frequency generator, and a press frame, applies localized "internal heat" to make spot and sectional cures within minutes. Elimination of the use of molds permits immediate repair of any size and shape of tire and prevents damage which results from over-heating large undamaged sections in the molds.

For the present the vulcanizing device promises motorized military units 10-min. tire repairs in combat zones by use of equipment weighing 500 lb and occupying a few square feet of space. Post-war possibilities were said to include both recapping and new tire production.

Recommendations for personal interest and individual care were made also in the discussion of care and maintenance of cooling systems, which were demonstrated to hold the fate of the engine itself, yet which

(Left to right) William J. Cumming, chairman, SAE-ODT Coordinating Committee; Emil P. Gohn, a member of both the General Committee for the meeting and the T&M Activity Meetings Committee; E. N. Hatch, chairman, T&M Activity Meetings Committee; and G. Ralph Strohl, a member of the General Committee for the meeting

receive on the average, maintenance attention so lacking as to border upon neglect. To support statements that cooling system maintenance customarily is nonchalant, field reports were cited as revealing that approximately one-fifth of cooling system failures are caused by clogging, corrosion, and ineffective thermostats. Another fifth is ascribed to internal leakage of coolant into engines through faulty joints, gaskets, and cracks in cylinder heads or blocks. External leakage, inadequate antifreeze protection, inaccurate testing, over- and under-filling, low coolant levels, air sucked into the system, and other causes were blamed for many other failures.

The suggestion was made that these and other ills, all forerunners of serious engine damage, could be prevented by proper inspection and maintenance of cooling systems, as outlined in the new U. S. Army manual of cooling system maintenance based upon the reports and recommendations of the SAE Ordnance Vehicle Maintenance Committee.

"Design for maintenance" bulked large on the horizon of cooling system maintenance. It was suggested that post-war radiators and other parts be designed and constructed for ease of maintenance as well as satisfactory operation. Large openings which fill rapidly without spillage, readily visible coolant level indicators, and large, accessible drain cocks and plugs which expedite discharge, were recommended as mechanical aids encouraging proper maintenance. Corrosion-resistant shafts for accessible water pumps, and water joints, hose clamps, and gaskets functionally satisfactory and easy to reach were said to serve the same commendable end.

Other recommendations for post-war cooling systems included rugged thermostats, variable-pitch fan blades, and thermostatic control of pump and fan speeds by water jacket temperatures. Closed cooling systems were said to have inherent and desirable advantages. Manufacturers were invited to make wider use of metals and metal combinations which are corrosion-resistant and to

All papers presented at this SAE National Transportation & Maintenance Meeting will appear in a later issue of the *SAE Journal* either in full in the Transactions Section or as digests

"Trucks as of 19—"
B. B. BACHMAN, Autocar Co.
"Factors of Design and Construction Affecting Cooling System Maintenance"
D. H. GREEN, National Carbon Co., Inc.
"Filters and the Sludge Problem"
E. G. GUNN, Fram Corp.
"What Truck and Bus Operators Should Know About Synthetic Tires"
J. E. HALE, Firestone Tire & Rubber Co.
"Hot Engine Sludge and Its Control"
H. C. MOUGEY, General Motors Corp.
"Cold Engine Sludge and Its Control"
B. E. SIBLEY, Continental Oil Co.
"Employment of Electronics for Effecting Tire Vulcanization"
LT.-COL. C. W. VOGT, Technical Staff for Supply

promote regular and proper use of corrosion inhibitors in coolants.

Prevention of sludge formation in the engines of commercial motor vehicles presented an interesting wartime and post-war problem complicated by many pertinent factors. It was made obvious that methods of controlling the formation of hot and cold sludges depend upon a high degree of maintenance.

Application of oil filters, control of engine temperatures, frequent crankcase draining, and use of high quality, heavy-duty oils were recommended as four steps to preventing engine damage from hot sludges. Filters were said to remove sludge as rapidly as it forms, temperature control to prevent excessive heat from causing oil oxidation and accelerating sludge formation, and crankcase draining to prevent sludge accumulations from becoming dangerously large.

Extensive research and survey work was indicated to underly the recommendations for control of cold sludges. Results of analysis of sludge problems in 37,108 vehicles operated in 37 fleets throughout the country – a continuing project of an SAE-API Coordinating Research Council Committee – were said to recommend the use of lubricating oils of the detergent type which, while representing no panacea, tend to free engine parts from sludge and also to discourage its formation.

Post-war suggestions here again came to the fore, this time by way of proposals that engine design improvements aid in controlling and curtailing sludge formation by facilitating the cleaning of oil passage ways and by assuring complete crankcase drainage.

Information developed also that the addition of new crankcase oil to old tends to promote sludge formation through curdling and precipitation of resins. It was pointed out that crankcase oil in vehicles operated on city streets reveals the effects of oxidation within a few thousand miles, and it was suggested that the way to keep oil really clean for more than 5000 miles is to use oil filters of adequate capacity and rapid cleaning rate. Effective oil filters, it was explained, remove abrasives and resins, but only such oil additives as adhere to solids.

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1944 SAE Handbook

Just off the press, the 1944 SAE Handbook reflects wartime industrial progress in developing new materials and methods in addition to revisions and rearrangements of previously existing standards.

Important new features include:

Revised classification of natural and synthetic rubber compounds; new specifications for medium- and heavy-duty coolant hose; revised and extended data and tables on steel hardness conversion numbers; revised standards for tube fittings on fuel and oil lines; new detailed standards for straight and taper pipe threads; new standards for spring lock washers; new nomenclature for pistons and piston rings; new standards for tractor power take-off and drawbar hitches, including safety protectors; revised specifications for nonferrous solders, and both cast and wrought aluminum, magnesium, and bronze bearing and bushing alloys.

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SAE WEST COAST TRANSPORTATION & MAINTENANCE MEETING

MULTNOMAH HOTEL
PORTLAND, ORE.

AUG. 24-25

PROGRAM

THURSDAY, AUG. 24

MORNING — Post-War Engines

Z. C. R. Hansen, Chairman

Possibilities of Gasoline Engine Development
– ***F. S. Baster, White Motor Co.***

Diesel*
– ***T. H. Maloney, General Motors Corp.***

AFTERNOON — Fuels & Lubricants

S. E. Onorato, chairman

A Solution of Present-Day Fuel Problems
– ***Prof. W. H. Paul, Oregon State College***

Relation of Lubrication and Filtration to Engine Life
– ***C. N. Bentley, DeLuxe Products Corp.***

FRIDAY, AUG. 25

MORNING — Maintenance

George Tharratt, chairman

Air Cargo – A Problem between Carriers on the Ground and in Flight
– ***R. D. Kelly, United Air Lines Transport Corp.***

AFTERNOON — Bus Transportation

Lee Ketchum, chairman

Post-War Expectations and Possibilities of Airborne (Helicopters) Bus Service
– ***Agnew E. Larsen, RotaWings, Inc.***

Surface Buses of the Future
– ***W. W. Churchill, Washington Motor Coach Co.***

DINNER

Friday 6:30 p.m.

***Title of paper to be announced.**

News..

..OF THE SOCIETY

CRC
Lubricants Research

ORGANIZATION of the Coordinating Lubricants Research Committee of the Coordinating Research Council, Inc., was completed May 17 in Chicago.

It was decided that the Executive Committee of CRC would serve as a liaison group for CLR on any problems handed up.

Army and Navy representation is provided on all the Divisions, Groups, and Panels of the two Divisions of the CLR, as in all of the CFR program. In general, long-range projects have been abandoned in favor of assignments in the interest of direct Government service. Project officers are Lt.-Col. R. F. Jeffrey, Majors H. F. Kley and Norman W. Faust, Capt. W. B Bassett, Office of the Chief of Ordnance, and Capt. J. H. Dea, Working Committee of the Army-Navy Aeronautical Board.

Serving under CLR Chairman C. G. A. Rosen, Caterpillar Tractor Co., are the Engine Oil, and the General Divisions headed by R. J. S. Pigott, Gulf Research & Development Co., and T. C. Smith, American Telephone & Telegraph Co., respectively.

The CLR Assignment Group which distributes projects among the various working groups of CLR, is composed of Walter G. Ainsley, executive vice-chairman, Sinclair Refining Co.; W. M. Holaday, Petroleum Administration for War; A. G. Marshall, Shell Oil Co., and B. E. Sibley, Continental Oil Co., the vice-chairman of the East, West, and Central regions, respectively; E. R. Barnard, Standard Oil Co. (Ind.); P. V. Keyser, Jr., Socony-Vacuum Oil Co., Inc.; H. C. Mougey, General Motors Research Laboratories Division, General Motors Corp.; Mr. Pigott; T. B. Rendel, Shell Oil Co., Inc., and Mr. Smith.

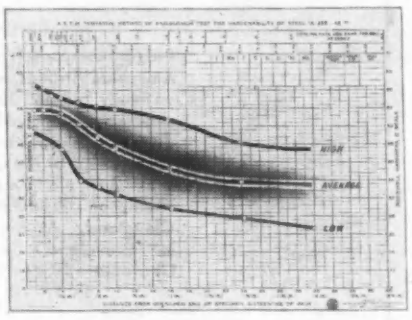
The leader of the Group on Engine Nomenclature is A. O. Willey, Lubri-Zol Corp. The Procedure Group is comprised of D. B. Brooks, National Bureau of Standards; Mr. Keyser; Leonard Raymond, Tide Water Associated Oil Co., and Mr. Sibley.

Engine Oil Division

Wide representation of petroleum technologists and internal combustion engineers has been obtained on the two main subdivisions of the Engine Oil Division under Mr. Pigott's chairmanship. These are known as the Motor Projects and the Aviation Projects, headed by Mr. Mougey and Mr. Rendel, directors of these two main working breakdowns of the Division, respectively. An Engine Survey Advisory Group of 19 top-ranking experts in all phases of lubrication research will advise with Mr. Pigott on overall problems. This and the Program Panel are headed by Dr. A. G. Cattaneo, Shell Development Co.

turn to p. 28

HARDENABILITY—



A New Design Tool

SAE Groups, AISI Develop Steel Strength Technique

JOINT issuance of a booklet "Tentative Hardenability Bands" by the SAE and the American Iron & Steel Institute will focus wide attention on one of the most active projects in the Society. Accelerated by the demand for conservation of critical materials in the manufacture of armament and weapons, hardenability bands as a new method for specifying steels by design engineers appear destined to become permanent and widely used tools for the metal working industries.

The objective of the effort:

To facilitate the selection and processing of steels on the basis of hardenability as an index of tensile strength with only corollary reference to chemical compositions.

Thus the tentative uniform method for specifying alloy steel on the basis of hardenability has been developed cooperatively by the Technical Committee on Alloy Steels of the American Iron & Steel Institute, the Iron & Steel Division of the SAE General Standards Committee, and the Iron & Steel Committee of the SAE War Engineering Board.

The new method to be described in the joint publication applies only to 37 standard steel analyses for which tentative hardenability bands are given in the pamphlet. Steels specified on the basis of hardenability will be designated by the usual SAE or AISI number followed by the code letter "H", thus 4130H. For those standard steels not included in the 37, minimum hardenability requirements consistent with minimum chemical compositions will apply until sufficient end-quench test data are available to establish full bands. Studies are now under way to determine these minimum limits.

The 37 analyses included in the forthcoming pamphlet are 4100H from 0.30 to 0.50 carbon inclusive, 4340H, 4620H, and the 8600H and 8700H series from 0.20 to 0.50 carbon inclusive. When these analyses are specified as "H" steels, modified chemistries which are given in the pamphlet apply. The tentative bands apply only to fine grain steels. Where coarse grain is desired, hardenability requirements will be determined by the producer and consumer.

The tentative bands are based on the SAE standard end-quench hardenability test using a 1-in. round test specimen. This test method, incidentally, is being reviewed by a subdivision of the SAE Iron & Steel Division, with a view to minimizing discrepancies in test results obtained by different laboratories.

The tentative hardenability bands will be reviewed at the end of a six-month period by the cooperating groups and, if experience indicates the need for modifications, revisions will be made.

Background of the SAE studies pointing toward this epochal development in steel specifying has been a number of papers pre-

sented at National and Section meetings over a period of years by exponents of the new philosophy expressed in hardenability curves. Following a symposium on Hardenability of Steels at the SAE Annual Meeting, Jan. 10, 1941, Detroit, (*SAE Journal*, July, 1941, p. 266) the SAE Iron & Steel Division developed a Recommended Practice on Method of Determining Hardenability. This was first published in the SAE 1942 Handbook.

As the nation swung into the task of supplying the Allies with weapons, the SAE cooperated in the development and made a major contribution in the application of the NE (National Emergency) steels at the request of the Government. Modifications were made in the NE steel list as the scrap situation shifted with the flood of high alloy turnings, drillings, and rejected parts found their way back to the steel mills. The hardenability test greatly facilitated this transition from the old to the new NE steels.

Inasmuch as little data had ever been compiled on the hardenability of the standard SAE steels, the SAE War Engineering Board in cooperation with the AISI undertook to collect and analyze test data with view of establishing hardenability bands on these steels. Results of this project are reported in a progress report which has just been issued by the joint AISI-SAE committee organized for this project.

The next step was a joint effort undertaken as the result of a conference of representatives of the AISI and the SAE, when it was decided:

1. To increase the effort to obtain and tabulate test data to show the hardenability characteristics of various steels;

2. To request revision of the SAE Standard Hardenability Test procedures in an effor to improve the correlation between the laboratories of both the users and steel mills.

A joint committee, with three representatives each of the AISI and the SAE was named to handle the work. Details were developed to eliminate errors found in the earlier collection of data. For example, standard test pieces made from the same heat were circulated with requests for test data.

The first progress report of this group has been approved and copies have been sent to those companies which contributed data. This report includes hardenability bands on 13 of the 85 steels on which the joint committee sought test data. Forty or more acceptable hardenability tests provide the basis for each of these 13 bands. However, calculated hardenability curves have been supplied on practically the entire 85 steels. To date, more than 2000 of these test data have been studied.

Standards for Packaging Aero Engine Parts Begun

STANDARD procedures for the preparation and packaging of spare aircraft engine parts will be developed by a subcommittee of SAE Aircraft Engine Subdivision's Committee E-9, to be known as E-9A headed by Paul J. Kondla, Pratt & Whitney Aircraft.

All engine spare parts will be listed in the final form of the standard, which will designate the method by which the part should be cleaned, what preservative should be used, method of application – such as hot or

Rambling Throug

Thompson Host to Cleveland May 8

BREAKING the record of all previous Section meeting attendance, over 950 **CLEVELAND SECTION** members were the dinner guests of SAE Past-President A. T. Colwell and the Thompson Products Co. on May 8. A tour of Thompson Aircraft Products' plant preceded the dinner at which Hollis R. Thompson, American Airlines, Inc., whose sudden death on July 7 was a shock and a loss to the aviation industry, talked on "Aviation Looks at a New World." Cleveland Section Chairman Harry F. Gray spoke briefly and Mr. Colwell, as sponsor for the meeting, presided as chairman and toastmaster . . . Speaking just two months before his unexpected death, Mr. Thompson predicted a great post-war world in which breakfast in Cleveland and dinner in London on the same day will be a usual thing . . . We are going to know our international neighbors better, he said, and avoid international friction . . . Many domestic airlines, Mr. Thompson said, have engaged in worldwide operations during the war and definitely and absolutely have proved their ability to provide international air service in the interests of peaceful commerce, national security and national policy . . . Judging by the services performed

SAE Past-President A. T. Colwell (left), Thompson Products Co., was host to Cleveland's largest Section meeting on May 8

Hollis Thompson (right), American Airlines, whose untimely death July 7 shocked the aircraft industry, was speaker of the evening at the great May 8 meeting at Thompson Products in Cleveland. At his left is Cleveland Section Chairman Harry F. Gray

by foreign air carriers before the war and with the knowledge that during the war period we have developed superior aircraft for air transport purposes as compared with other nations, he continued, coupled with the fact that we now know more about ocean flying than the nationals of any other country, we have no fear from a competitive angle . . .

The huge plant dining room at Thompson Aircraft Products was large enough to accommodate the nearly one thousand guests who attended the dinner and who joined those who had spent an instructive and enjoyable day watching the work of one of the country's foremost aircraft parts plants . . .

Master of ceremonies at **INDIANA SECTION** June 15 meeting was Harry Hartz, famous former pilot and automobile racing star, and now a member of GM's Allison Division . . . acted as commentator on 36-min color film taken and presented by Karl Kizer, Century Tire Co., of the historic 500-mile Indianapolis race of 1941 . . . enlivened the picture by calling shots of the contest and introducing scores of track-side actors, who offstage play important parts in the automotive industry . . .

Design, production and maintenance engineers gathered with metallurgists when **METROPOLITAN SECTION** presented A. L. Boegehold, General Motors Research, on the subject of Hardenability on June 1 in the Pennsylvania Hotel . . . One of

Section Reports

the pioneers among the automotive and steel industry metallurgists in the field of hardenability testing, the speaker pointed to hardenability as the optimum method of specifying steel . . . Vice-Chairman Harold F. Blanchard introduced International Nickel's Thomas H. Wickenden as the technical chairman of the meeting . . . Nearly half of the audience of 450 were members of the American Society for Metals and the American Welding Society, who had been invited to hear the first presentation of this subject to a combined group of engineers and metallurgists . . .

Farewell address by Retiring Chairman A. G. Cattaneo prefaced open forum meeting on fleet maintenance problems of **NORTHERN CALIFORNIA SECTION** June 12 . . . Some slides were shown which described construction and use of a rear axle housing straightener, while others illustrated the effect of improper bearings on engines and their operation . . . Panel discussion disclosed the following information: chromium plating of crankshafts produces better service than metal spraying . . . a cold welding process using pure nickel electrically deposited is available for cracked cylinder heads . . . the problem of increased engine deposits can best be helped by arranging for the intake manifold to run warmer. Periodic sandblasting of the inside of the intake manifolds is recommended to make the intake manifold run hotter and therefore vaporize better . . . wider rimmed tires give improved performance . . .

Cocktail party, stag dinner and entertainment put **OREGON SECTION** members in gay mood for last meeting of the season June 14, when new officers were installed and past chairmen were honored with gavels . . . Scroll given to Z. C. R. Hansen, who presided for year 1943-1944 . . .

Non-technical program for members and their wives featured by **PHILADELPHIA SECTION** May 10 . . . Katherine Clark, commentator for WCAU, stressed the need for a better understanding on our part of the attitude of citizens of nations directly in the conflict areas of the war, particularly of the younger generation . . . Political trends also discussed by principal speaker Dr. Michael Dorizas, professor of geography at University of Pennsylvania, who presented officially-released Russian movies showing some of the most dramatic action in German invasion of Russia as well as many aspects of industrial development which have taken place within that nation to provide the defenders with supplies and equipment necessary to repel the enemy . . . Feminine contingent later received sets of coasters bearing SAE insignia as a token of their welcome . . .

Climaxing meetings of **ST. LOUIS SECTION** was June 13 session, which excluded speeches from its program of three films and a Dutch lunch . . . "Lest We Forget," shown first, was a parade of old-time automobiles in the days of the great automotive pioneers . . . then came "Precisely So," a display of the precision measurement which has made the modern automobile and airplane possible . . . finally, "Along the Great Silk Route," a technicolor version of one of the world's oldest and greatest commercial highways, extending from France and Germany through the Balkans to Turkey, Iraq and India . . . Hobby contest was added attraction, and a committee composed of George C. Dorris, A. F. Stoehr, and W. H. Strasser offered three prizes of $5 each . . . Winners were B. E. Garner, who exhibited a lathe attachment for boring connecting rod bearings . . . Chairman Fred Roever for his Improved New Contemporary Confidence Contraption and Candid Complimentor, a development which could be strapped around the waist and administer pats on the back of varied intensity . . . Carl Farnstrom, as a result of his labors on a beautiful inlaid checkerboard table made of a combination of walnut and maple . . .

Over 100 representatives of **SYRACUSE SECTION** attended inspection trip of Naval Diesel Engineering Laboratory at Cornell University May 15 . . . after touring the laboratory, the group was given an operating demonstration on a 12-cyl GM main propulsion diesel on a pair of Cummins diesel generator sets . . . included in equipment on display were engines from 2 to 16 cyl, and from 30 to 1600 hp, covering such types as 2 and 4-stroke cycle engines, both single and double acting; opposed piston engines; mechanically-driven scavenging blowers and superchargers, and turbosuperchargers . . .

Illustrating his talk on Military Vehicles with various vehicles of war, SAE Past-President A. T. Colwell told **MUSKEGON GROUP** at its May 25 meeting that while we had one vehicle for every 90 men in the last war, today we have one for every nine men . . . he praised the work of the Army Ordnance Department, rating it as an all-star war team . . .

Three principal speakers at **PEORIA GROUP** meeting June 19 made for interesting session . . . The manner in which heat is transferred from the combustion gas to the pistons of internal combustion engines is important from the standpoint of piston and combustion chamber design, according to Carl H. Paul, Caterpillar Tractor Co., who discussed Heat Flow in Pistons . . . Ralph J. King, same company, said that high-speed internal combustion engine pistons, by virtue of the functions they must perform, are the most critical and difficult part of the engine to design . . . Talking about gaseous fuels for internal combustion engines, Dr. Richard Wiebe, Northern Regional Research Laboratory, dealt principally with fuels obtainable from portable gas generators such as are being used extensively in Europe and other parts of the world . . .

cold dip or sprayed – how the part should be wrapped, supported, and packed, and show the type of final or outside container, depending upon whether it is to be stored or shipped and by what means.

The proposed chart will be supplemented by a few paragraphs explaining procedures, and photographs showing step-by-step progression in the proper method of preparing and packaging typical parts.

Working through the Working Committee of the Army-Navy Aeronautical Board, the Packaging & Container Unit of the AAF Materiel Command, and with other agencies interested in this problem, complete coordination of best practices will be assured.

Serving with Chairman Kondla on Committee E-9A are R. I. Beddoe, Ranger Aircraft Engines; P. J. Frame, Aircooled Motors, Inc.; R. N. Hait, Wright Aeronautical Corp.; R. L. Heath, Allison Division, General Motors Corp.; G. H. Lamore, Jacobs Aircraft Engines, and H. J. Wagner, Lycoming Division, The Aviation Corp.

Aero Fittings Project Undertaken by SAE Group

As a result of exhaustive studies of the requirements of aircraft fittings and flexible hose assemblies, a new series of standards will be developed for the Army-Navy Aeronautical Board and industry by the SAE Aircraft Accessories & Equipment Subdivision's Committee A-3 on Aircraft Valves, Fittings, and Flexible Hose Assemblies.

This decision was reached at a meeting from July 27 to 30 at the AAF Materiel Command, Dayton, when representatives of the Army, Navy, National Aircraft Standards Committee, and manufacturers met with Committee A-3 under the auspices of the Working Committee of the Army-Navy Aeronautical Board.

About six months ago, the committee undertook a study of the 3000-odd fittings specifications in use in the United States. A tentative reduction to 700-odd was made, including some as suggested by the Army and Navy. Both services agreed to specify the same series of standards if general agreement could be reached. One group of suggestions, submitted by the NASC, contained more than 50 pages.

The Dayton meeting reached basic agreement on the series to be developed, discussed each specification considered with the Services, and has undertaken to complete the proposed series which will be submitted to the Army and Navy.

The project will greatly simplify the manufacture and maintenance of military aircraft, although some of the older standards will be continued for a time for replacement on older equipment now in use.

Chairman L. J. Henderson, Weatherhead Co., R. H. Davies, Parker Appliance Co., and Rollin C. Bergh, Republic Aviation Corp. and the NASC liaison on the committee, were responsible for much of the preliminary work which involved correlating opinions of more than 75 equipment manufacturers. Serving with these gentlemen on Committee A-3 are M. Brandeau, Aeroquip Corp.; J. M. Roth, Pesco Products Co.; William L. White, Manhattan Rubber Mfg. Division, Raybestos-Manhattan, Inc., and William L. White, Douglas Aircraft Co., Inc.

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LUBRICANTS

cont. from p. 25

The eight main groups, some with several specialized working panels, have been set up as the working force of Mr. Mougey's Motor Projects. They are Program & Analysis, headed by Director Mougey; Oxidation Tests 27 members and two panels, Mr. Sibley; Low Temperature Characteristics, Dr. J. C. Geniesse, Atlantic Refining Co.; Full-Scale Engine Tests of SAE 50 Grade Oils, Mr. Willey; Rust Preventives, W. E. Kuhn, The Texas Co., composed of 21 members and with six panels; Additives, M. M. Roensch, Chrysler Corp., with nine members; Foaming, H. A. Ambrose, Gulf Research & Development Co., 15 members and two panels; COS (Crankcase Oil Stability) Bench Test, C. W. Georgi, Quaker State Oil Refining Co., a group of 30 technologists and engineers, with three panels.

Mr. Sibley's Oxidation Tests Group were members of the Petroleum Group under the former CLR Engine Oil Test Methods Projects, with the addition of some of the Automotive Group, which has been disbanded. A part of the assignment of the Standardization Panel, also headed by Mr. Sibley, was consideration of these recommendations:

Engine cleaning should be closely specified and standardized; standard jet conditions should be maintained; standardize on rings and pistons, bearing fits, improved connecting rods and heavier bearing liners for Cu/Pb bearings, methods of oil temperature control, exhaust piping details, crankcase ventilation control, method of determining air-fuel ratio, new engine break-in to assure having catalytic – as well as mechanical – uniformity, carburetor air-fuel ratio control, and cleaning material and method of cleaning Cu/Pb bearings.

Under the former organization, the Engine Oil Division's motor projects were under the CLR Engine Oil Performance Properties Projects. The new Low Temperature Characteristics Group is attempting to obtain better correlation of laboratory results and actual performance of oil in service. It will continue with no change in its personnel, Mr. Mougey announced. Work has been done by the former Cold Starting Group, also under Dr. Geniesse.

Mr. Willey's Group on Full Scale Engine Tests of SAE 50 Grade Oils is working on an investigation of test procedures for this grade of lubricating oil to assist in determining requirements in Specification 2-104B.

Aviation Projects

The Cooperative Oil Test and the Cooperative Universal Engine Test Groups comprise the Aviation Projects of the Engine Oil Division under Director Rendel. His COT Engine Group is headed by Mr. Georgi, leader, with 24 members, and represents a cross section of the best lubricant research laboratories, technicians, and other facilities in the country. It has three panels. The Army Air Forces, the National Advisory Committee for Aeronautics, and seven petroleum refinery companies have been shipped a total of 20 COT engines, and the Army, Navy and 12 companies will receive 25 of the second production lot of engines. Test work from these laboratories will be correlated by Mr. Georgi's group.

The Cooperative Universal Engine Test Group of Mr. Rendel's Aviation Projects is headed by Mr. Ainsley who is leader of the 13 technologists representing Government agencies and industry, and has two panels. Test results on projects being carried out on 30 CU Engines by 16 Government agencies and industry laboratories and 10 engines overseas are being correlated by this group.

General Division

Gear Oils, Greases, and Hydraulic Fluids are the three main projects of the General Division of the Coordinating Lubricants Research Committee headed by Mr. Smith as chairman, and G. K. Brower, American Airlines, Inc., as vice-chairman. Its Steering Group has 12 members under Mr. Smith. Groups of projects are: Gear Oils, Mr. Keyser, director, with three groups: Program and Analysis, and Universal Gear Lubricants, headed by Mr. Keyser, with 10 panels, and one on Low Temperature Properties, Mr. Moir.

The second main group of projects of Mr. Smith's General Division is that on Greases, and is headed by Mr. Ainsley as director. His three groups are one on Program and Analysis which he heads, Performance, with nine panels, and the third on Properties, with seven panels, both headed by E. W. Adams, Standard Oil Co. (Ind.)

Hydraulic Fluids is the third group of projects of Mr. Smith's General Division and is directed by E. R. Barnard, Standard Oil Co. (Ind.) with a Performance Group, headed by F. L. Miller, Standard Oil Development Co., with three panels, and a Hydraulic Fluids Properties Group under O. L. Brandes, Gulf Research & Development Co., with two panels.

Review A-N Specifications and Standards

Members of SAE Aircraft Engine Subdivision Committees E-5A and E-5B met May 23 in New York to review the specifications and standards for A-N Standard Parts at the request of the Engine Technical Committee of the Aeronautical Chamber of Commerce of America. The aircraft engine manufacturers, recognizing the maintenance problems of the Services, agreed through the ETC to use A-N standard parts, provided the specifications were revised by the Services in accordance with the recommendations of the aircraft engine industry. Seated (left to right): J. Robbins, Aircooled Motors Corp.; W. W. Hayes, chairman of Committee E-5A, Jacobs Aircraft Engine Co.; H. T. Dreyer, Continental Aviation & Engineering Corp.; M. E. Mills, chairman of Committee E-5, Wright Aeronautical Corp.; E. W. Rentz, Jr., SAE staff, and Capt. D. L. Drumm, Working Committee, Army-Navy Aeronautical Board. Standing (left to right): D. Johnson, Jacobs Aircraft Engine Co.; H. C. Beyer and R. H. Runge, Ranger Aircraft Engines; William Shields, Pratt & Whitney Aircraft; R. C. Bergh, Republic Aviation Corp.; J. E. Jackson, chairman of E-5B, Pratt & Whitney Aircraft, and H. W. Epler, Lycoming Division, The Aviation Corp.

Aero Air Filter Revisions Under Way

AT the request of the Engine Technical and the Aircraft Technical committees of the Aeronautical Chamber of Commerce of America, the SAE Aircraft Engine Subdivision's Committee E-17 has undertaken to recommend revisions of the AN F-30 specifications for Carburetor Air Filters, and the AN I-8, Installation of Carburetor Air Filters.

The project is being thoroughly coordinated with the National Aircraft Standards Committee of the ACCA as a joint report.

Under the chairmanship of Wayne Cannon, Wright Aeronautical Corp., the committee is composed of H. G. Braendel, Continental Motors Corp.; R. N. DuBois and C. R. Paton, Packard Motor Car Co.; A. S. Horwath, Pratt & Whitney Aircraft; William S. James, Studebaker Corp., and D. E. Moore, Ranger Aircraft Engines.

SAE Will Coordinate Aero Electrical Unit Standards

UNDER terms of an agreement between the American Institute of Electrical Engineers, National Electrical Manufacturers Association, National Aircraft Standards Committee, and the SAE, Committee A-2 on Aircraft Electrical Equipment of the SAE Aircraft Accessories & Equipment Subdivision continues as the "central responsible committee for the standardization of aircraft electrical equipment," including these functions:

1. Development of industry (SAE) standards for aircraft electrical equipment, and

2. Coordination of industry comments on proposed Government specifications when required either by the Government or industry.

The plan, concluded June 19 by representatives of the interested groups, unifies the standardization efforts in this field in the interest of preventing duplication of effort.

For example, a permanent subcommittee on Circuit Breaker Standards, was formed at this meeting under the chairmanship of E. G. Haven, General Electric Co. It will have representatives from the Army Air Forces, Navy Bureau of Aeronautics, National Aeronautics Standards Committee of the Aeronautical Chamber of Commerce of America, Working Committee of the Aeronautical Board, American Institute of Electrical Engineers, National Electrical Manufacturers Association, and manufacturers of circuit breakers.

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Jet Propulsion To Be Gen. Echols' SAE Topic

MAJOR-GEN. OLIVER P. ECHOLS, Assistant Chief of Air Staff for Materiel, Maintenance and Distribution, is scheduled to talk on the vital subject of jet propulsion airplanes at the SAE National Aeronautic Meeting in Los Angeles on Oct. 5. Dealing with the most talked-about technical development of the current war, this paper will be one of the most important presented before the Society in some time.

W.E.B. Issues Dust Report

A 132-page report, "Dust-Proofing Military Motor Vehicles," Progress Report No. 2, has been submitted to the Army Ordnance Department by the SAE War Engineering Board.

The report contains 33 pages of photographs, 12 pages of tables, eight pages of charts, and five pages of diagrams. It was prepared by the Dust Technical Committee headed by John G. Wood, assistant chief engineer, Chevrolet Motor Division; T. M. Ball, experimental engineer, Chrysler Corp.; J. M. Davies, assistant director of research, Caterpillar Tractor Co.; W. S. James, chief engineer, Studebaker Corp.; L. F. Overholt, assistant to the chief engineer, International Harvester Co.; E. H. Shepard, carburetor engineer, Chevrolet Motor Division, and R. L. Weider, experimental engineer, White Motor Co.

The Dust Steering Committee was headed by R. R. Teetor, vice-president, Perfect Circle Co.; H. S. Eberhard, vice-president, Caterpillar Tractor Co.; J. M. Crawford, chief engineer, Chevrolet Motor Division; Mr. James; A. W. Scarratt, vice-president, International Harvester Co., and J. C. Zeder, chairman of the War Engineering Board and chief engineer of Chrysler Corp.

The study was developed in accordance with directives from the Army Ordnance Department.

17th Meeting of the CRC's War Advisory Committee

The seventeenth meeting of the Coordinating Research Council's War Advisory Committee was held in The Pentagon Building on March 16 and 17. This committee, under the chairmanship of J. B. Macauley, Pratt & Whitney Aircraft, has assisted the Ordnance Department in the development of fuels and lubricants, with the characteristics required for the military operation of Ordnance equipment. The committee first met in September, 1941, and has considered more than one hundred problems, many of which have been passed on to the appropriate Coordinating Research Council Working Groups for technical investigations. Progress reports of these working groups on Ordnance Problems were presented at the recent committee meeting with Major-Gen. G. M. Barnes, chief of the Technical Division, Ordnance Department, and Brig.-Gen. H. L. Peckham, director, Fuels and Lubricants Division, Office of the Quartermaster General in attendance. The Coordinating Research Council is jointly sponsored by the Society of Automotive Engineers and the American Petroleum Institute, thus making available the combined research facilities of the automotive and petroleum industries to the Ordnance Department on fuels and lubricants development.

Seated (left to right): C. G. A. Rosen, vice-president and director of research, Caterpillar Tractor Co.; Major-Gen. G. M. Barnes, chief, Technical Division, Office Chief of Ordnance; Brig.-Gen. H. L. Peckham, director, Fuels & Lubricants Division, Office of the Quartermaster General; J. B. Macauley, research engineer, Pratt & Whitney Aircraft. Standing (left to right): John M. Campbell, research engineer, General Motors Research Division; R. J. S. Pigott, chief engineer, Gulf Research & Development Co.; George J. Heubner, Jr., assistant to executive engineer, Chrysler Corp.; J. M. Crawford, chief engineer, Chevrolet Division, General Motors Corp.; A. L. Beall, research engineer, Wright Aeronautical Corp.; C. B. Veal, manager and secretary, Coordinating Research Council; J. B. Fisher, vice-president in charge of engineering, Waukesha Motor Co.; Dr. Raymond Haskell, consulting engineer, The Texas Co. W. M. Holaday, assistant director of refining, Petroleum Administration for War, was absent from the meeting

Col. Bernt Balchen, manager of Norwegian Airlines, New York City (left), is shown examining a map of Greenland and telling the story of his experiences there to Major Corey Ford (right), where for 119 days he directed a rescue party to a cracked-up plane in the most inaccessible bit of territory on the Northern Hemisphere. Details of this incredible adventure are described in "War Below Zero," co-authored by Col. Balchen, Major Ford, and Major Oliver La Farge, a survivor of the crash

About SAE Members

MAJOR ARTHUR F. DeLONG has been transferred from A. P. O. 574 to A. P. O. 350, c/o Postmaster, New York City.

A. H. BATCHELDER has been named assistant director of Richmond Laboratories, California Research Corp., Richmond, Calif. This company has taken over the work of the Research & Development Department of Standard Oil Co. of Calif., of which Mr. Batchelder was formerly assistant manager.

JOHN F. WOLFRAM, for the past 16 years identified with Oldsmobile Division's engineering department, and assistant chief of all product engineering since 1940, was recently promoted to chief engineer of the division.

John F. Wolfram

LT. R. L. OBLINGER, U. S. Army Field Artillery, has been transferred from the Motor School Division at Fort Bragg, N. C., to the Field Artillery School, Fort Sill, Okla.

COM. ROBERT C. JEWELL has returned from active service and is now temporarily assigned to the receiving unit at Ellis Island, N. Y.

JOSEPH PISTRANG, seaman first class, may be reached at United States Naval Training Center, Great Lakes, Ill. He was formerly a student at Chrysler Institute of Engineering.

Z. TED RAJEWSKI is now an ensign in the U. S. Navy, stationed at Naval Training Station (I), Fort Schuyler, N. Y. He had been a student at Chrysler Institute of Engineering.

SAE members who have been elected to a two-year term of office on the executive committee of ASTM include: **J. T. MacKENZIE,** chief metallurgist, American Cast Iron Pipe Co., Birmingham, Ala.; **J. G. MORROW,** chief metallurgist, Steel Co. of Canada, Ltd., Hamilton, Canada; and **SAM TOUR,** president, Sam Tour & Co., Inc., New York City.

JAMES P. HUNSAKER is now in the U. S. Navy as an ensign, E-V(S), at the Bureau of Ships, Washington. As a civilian he had been assistant project engineer for American Bosch Corp., Springfield, Mass.

C. M. BELINN, who was formerly vice-president of Hawaiian Airlines, Ltd., Los Angeles, recently resigned his position.

WILLIAM G. DALLAS is no longer production supervisor for Titeflex, Inc., Newark, N. J., having entered the U. S. Army recently. He is stationed at Fort McClellan, Ala.

THEODORE D. BUETTELL, formerly process analyst for Douglas Aircraft Co., Inc., Santa Monica, Calif., is now at the U. S. Naval Training Station, Great Lakes, Ill., as seaman first class.

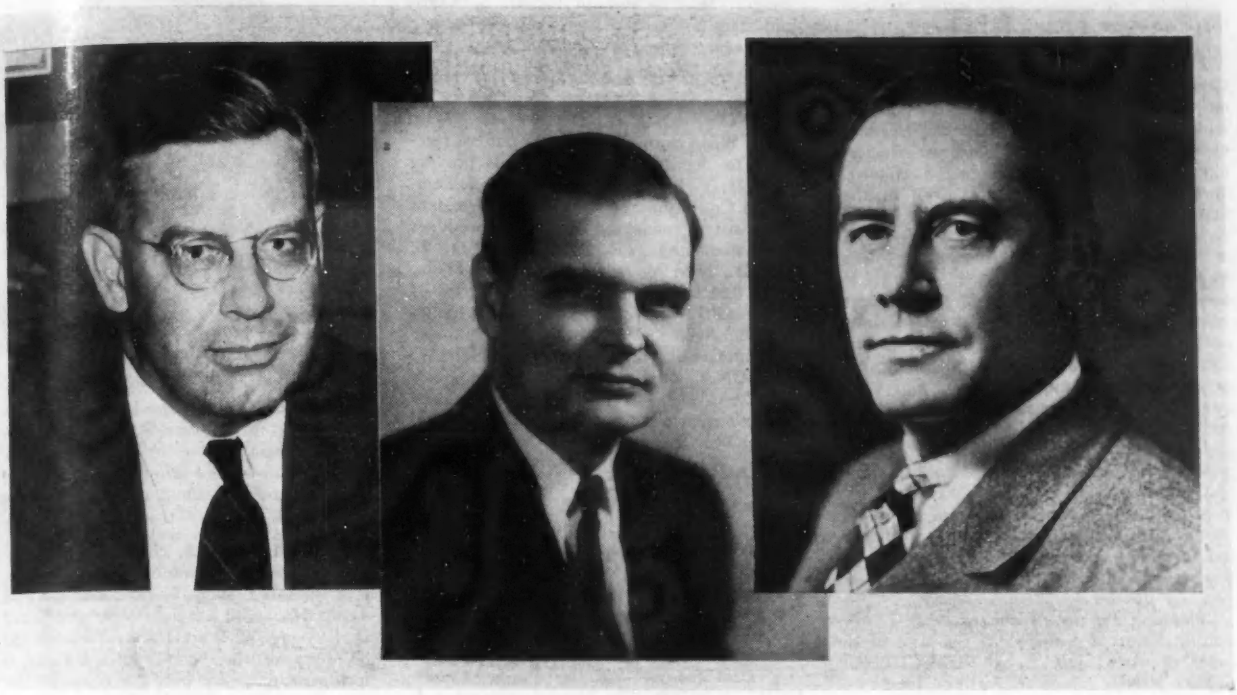
JOSEPH J. JACOBS has joined Chemurgic Corp., Richmond, Calif., as vice-president of the company. He had been employed as senior chemical engineer for Merck & Co., Rahway, N. J.

RAYMOND L. MUSSATTO, previously research engineer for Caterpillar Tractor Co., Peoria, Ill., has enlisted in the U. S. Maritime Service, and may be reached at the U. S. Maritime Service Training Station, Hoffman Island, Staten Island, N. Y.

SAE Councilor **HAROLD T. YOUNGREN** has been appointed director of engineering development of Borg-Warner Corp., Chicago, according to an announcement by **C. S. DAVIS,** president of the company. Mr. Youngren, who had been chief engineer with Oldsmobile Division since 1933, will supervise Borg-Warner's research laboratories.

Harold T. Youngren

Changes Within Wright Aeronautical



Myron B. Gordon | Philip B. Taylor | G. M. Williams

G. M. **WILLIAMS,** senior vice-president of Curtiss-Wright Corp. in charge of the engine company's activities, has succeeded **MYRON B. GORDON** as executive vice-president of Wright Aeronautical Corp., in addition to his former duties. Mr. Gordon, who for five years directed Wright through one of the greatest expansions of any corporation in the nation, bringing engine output up to the point where more horsepower is now produced in a day than in a pre-war month, has resigned to take a well-earned vacation before carrying out plans for the future. Executive administration of the company will now be handled by Mr. Williams and **PHILIP B. TAYLOR,** who continues as vice-president and is now acting general manager, President **GUY W. VAUGHAN** of Curtiss-Wright Corp. and Wright Aeronautical Corp., has announced. Mr. Williams has been preparing for this job for a year.

JOHN D. WAUGH, who had been an instructor in aircraft propellers for Lockheed Overseas Corp., is now technical project specialist, service department technical section of Curtiss Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

CARROLL I. HENWOOD, JR., formerly laboratory supervisor and instructor at the Naval Training School, University of California, Berkeley, Calif., is now powerplant engineer assigned to flight test engineering work for Trancontinental & Western Air, Inc., Kansas City, Mo.

LT. EDWARD A. SUTHERLAND, AAF, has been transferred from Combat Crew Headquarters, Army Air Base, Camp Blythe, Calif., to overseas service, where he may be contacted at A. P. O. 558, c/o Postmaster, New York City.

MAJOR GERALD C. DUNBAR, U. S. Army Ordnance Department, who was formerly located at A.P.O. 182, c/o Postmaster, Los Angeles, may now be reached at the 213th Ordnance Battalion, Camp Forrest, Tenn.

Following his re-election as vice-president and director of Norma-Hoffmann Bearings Corp., Stamford, Conn., **HAROLD J. RITTER** resigned from the company. His future plans have not been announced.

D. E. BATESOLE has recently been named vice-president of Norma-Hoffmann Bearings Corp., Stamford, Conn. He retains his former title of chief engineer, a post which he has held since 1937. Mr. Batesole is chairman of the SAE Ball & Roller Bearings Division.

EMORY SCOTT LAND, chairman of the Maritime Commission and chief of the War Shipping Administration, was promoted from rear-admiral to vice-admiral under legislation signed by President Roosevelt. Admiral Land, then a captain in the Navy, was appointed chairman of the SAE Aircraft

Directs Engineering of Packard Project

Packard Motor Car Co. has just established a separate division in its Toledo plant "to handle advanced aircraft engine development at the specific request of the Army Air Forces Materiel Command" and has named C. R. Paton as directing engineer of the project. Mr. Paton, with Packard since 1930 and former chief engineer until his release in 1942 to accept a special war assignment including an engine survey in the Middle East theater, is now recruiting a staff of engineering specialists expected to total several hundred

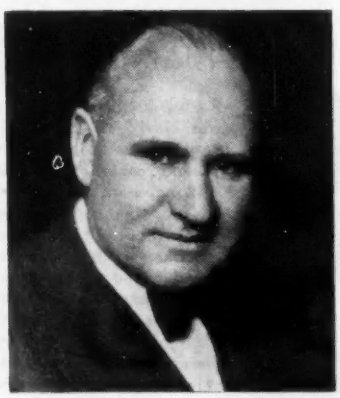
Engine Subdivision in 1928, and helped to lay the fundations of the present aeronautical standards and engineering research work of the Society.

Prepared and edited by **HERBERT CHASE** is a recently published "Handbook on Designing for Quantity Production" to which **CHARLES L. TUTT, JR.,** assistant professor of mechanical engineering, Princeton University, has contributed a chapter. Specific rules for design are given in the first part of the book, and the reasons for each rule explained. In this respect the book is novel, because many technicians have felt formulation of such rules to be difficult if not impossible. The second part of the volume, written entirely by Mr. Chase, compares the relative advantages and disadvantages of die casting and sand-casting, of permanent mold and die castings, of various types of nonferrous castings, of die cast and screw machine products, of cold-headed and screw-machine products, and of die castings and plastic moldings. Published by McGraw-Hill Book Co., the volume applies to virtually every product intended for manufacture in large quantities and involving the use of metals or plastics. Mr. Chase is associate editor of "Aviation."

"Planning for an Airline from an Engineering Point of View" was the title of a paper presented July 2 by **TIEH-CHENG (TED) NING,** American Airlines, Inc., before the Chinese Institute of Engineers, America Section, Hotel New Yorker. Mr. Ning is a member of the engineering staff of the company, and came to the United States in 1936. His father, Gen. Mongyeng Ning, is a member of the Chinese High Command Advisory Council, Chungking.

LOUIS JOHN FLEISHMAN, formerly flight engineer for the African-Orient Division, Pan American Airways System, Inc., Miami, Fla., is now with Pan American World Airways, Inc., New York City, as assistant chief flight engineer of the Latin American Division.

DR. ZAY JEFFRIES, pioneer in tungsten metallurgy and in the development of high-strength aluminum alloys, has been elected



Dr. Zay Jeffries

to the board of trustees of Battelle Memorial Institute, industrial research organization. Dr. Jeffries is technical director of the lamp department of General Electric Co., Cleveland.

LAWRENCE A. SMITH, formerly branch manager for International Harvester Co., Bangor, Me., is now in the U. S. Army, and may be reached at A.P.O. 15380, c/o Postmaster, New York City.

SAE members who have received recent changes in company status are: **CRAIG W. CANNON,** Allis-Chalmers Mfg. Co., West Allis, Wis., from assistant laboratory foreman to foreman in charge of proving grounds; **T. R. BROUILLETTE,** L. S. Donaldson Co., Minneapolis, from vice-president and assistant managing director to president and managing director; **HAROLD L. BROCK,** Ford Motor Co., Dearborn, Mich., from draftsman to engineer in charge of tractors; **BOYCE W. KNIGHT,** Young Radiator Co., Racine, Wis., from field engineer to engineering representative; **JOHN W. CARSON,** Continental Aviation & Engineering Corp., Detroit, from research engineer to performance and test engineer; **R. O. SNODGRASS,** Union Oil Co. of Calif., Seattle, Wash., from sales promotion work in lubricants to special clerk in charge of lubricant sales; **NEVILLE M. REINERS,** Cummins Engine Co., Columbus, Ind., from design engineer to technical analyst; **R. A. ST. JOHN,** Heald Machine Co., Worcester, Mass., from Cleveland branch manager to Detroit branch manager; **C. L. GILLHAM,** Willys-Overland Motors, Inc., Toledo, Ohio, from technical service representative to special representative on the Pacific Coast; **JOHN R. WERGER,** Wright Aeronautical Corp., Paterson, N. J., from engineering trainee to production liaison engineer; **ALBERT J. MILLER,** Pan American Airways, Inc., La Guardia Field, N. Y., from apprentice engineer to junior engineer; **MAJOR ALLEN TAYLOR,** Headquarters, Army Service Forces, Camp Reynolds, Pa., from ordnance officer to director of maintenance; **O. L. OLSEN,** Electro-Motive Division, General Motors Corp., La Grange, Ill., from district service engineer to field manager of the eastern region in New York City; **GEORGE TRUE LUNDY,** U. S. Army Air Forces, Air Service Command, San Bernardino Air Depot, Calif., from final testing engineer to crew chief of the carburetor department; **ALBERT F. WAGNER,** American Bosch Corp., Springfield, Mass., from district manager and field engineer in the middle states to application engineer; **ROBERT HUNT,** Seaboard Air Line Railway, from assistant general superintendent of motive power in Savannah, Ga., to general superintendent of motive power in Norfolk, Va.; **CLARENCE W. MYERS,** Detroit Transmission Division, GMC, from superintendent in the department of transmissions to superintendent of engineering in the experimental laboratory; **ANDREW N. SMITH,** General Electric Co., from the Schenectady, N. Y., branch to the Pittsfield, Mass., office; **H. LOUIS,** Canadian Pacific Air Lines, Ltd., from project engineer in Edmonton, Canada, to head of the engineering department in Winnipeg; **A. WHEELER WARREN,** Lockheed Aircraft Corp., Burbank, Calif., from engineering representative to powerplant engineering designer; **HAROLD S. GLADWIN, JR.,** Boeing Aircraft Co., Seattle, Wash., from assistant group engineer of flight test unit to field service engineer; and **ROBERT A. SCHORR,** Metal Manufacture & Repair Shops, Mobile Air Service Command, Brookley Field, Ala., from general foreman of aircraft shops to general foreman in charge of machine shop branch.

G. N. Gascoigne

G. N. GASCOIGNE, who had been associated with the National Refining Co., Cleveland, as manager of the fleet sales department, is now vice-president in charge of development and sales for Kemsol Sales Co., same city.

J. C. HUNSAKER, chairman of the National Advisory Committee for Aeronautics, is a member of a 12-man committee of Army, Navy and scientific experts nominated by Secretary of War Henry L. Stimson and Secretary of the Navy James Forrestal to formulate plans for post-war research. One of the principal objectives is to set up this organization in such a way that it will be responsive to new and daring ideas in warfare and will not be open to the charge of "brass hat" conservatism or interference.

A. C. TEETSEL, formerly vice-president and general manager for Ferodo & Asbestos, Inc., New Brunswick, N. J., has been appointed manager of friction materials manufacturing of Thermoid Co., Trenton, N. J.

Formerly junior engineer at Wright Aeronautical Corp., Paterson, **HAROLD I. FINK** is now with National Advisory Committee for Aeronautics, Cleveland, as mechanical engineer.

ALFRED PETOSKY, previously a student at Detroit Institute of Technology, is now in the U. S. Navy, stationed at the U. S. Naval Training Center, Great Lakes, Ill.

HENRY C. REINBERG has joined the Department of Revenue for the State of Louisiana, Baton Rouge, La., as chemical engineer. He was formerly connected with J. S. Abercrombie Co., Sweeny, Tex.

PERCE E. GARLENT, who had been vice-president for Lycoming Division, Aviation Corp., Williamsport, Pa., is now assistant plant manager in charge of manufacturing at Wright Aeronautical Corp., Woodridge, **N. J.**

N. NEAL STOFFLE, formerly engineer for United Air Lines Transport Corp., Chicago, is now flight test engineer for Pratt & Whitney Aircraft, East Hartford, Conn.

SHERWIN H. WRIGHT, previously industry engineer for Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is now connected with Ebasco Services, Inc., New York City.

JOE M. LYON, JR., U. S. Army, has been transferred from Camp Abbot, Ore., to Fort Lewis, Wash., where he is in the Engineers' Section.

SAE student members newly engaged in engineering work at various production plants throughout the country include:

	Formerly at	Employed by
EUGENE S. REYNOLDS	General Motors Institute	Guide Lamp Division, GMC
ROBERT SCOTT McPHERSON	Oregon State College	Chinook Telephone Co.
VICTOR ROY TALBOTT	Aero Industries Technical Institute	Boeing Aircraft Co.
DAVID W. JOHNSON	Ohio State University	National Board of Boiler & Pressure Vessels
CHARLES E. DeVAULT, JR.	Purdue University	Studebaker Corp.
PAUL C. ZMOLA	Purdue University	Western Electric Co.
FREDERICK OLLILA	Fenn College	National Advisory Committee for Aeronautics

GEORGE ALEVIZON is now in the U. S. Marine Corps, stationed at Parris Island, S. C. Before entering the service he was junior field engineer for Ranger Aircraft Engines, Farmingdale, L. I., N. Y.

SAE members who have recently been elected officers of the Pressed Metal Institute are **F. C. GREENHILL,** vice-president of Acklin Stamping Co., Toledo, who was named president, and **C. W. CUSTER,** American Stamping Co., Cleveland, who is chairman of the Cleveland district.

W. W. SLAGHT, Cleveland Steel Products Corp., has been promoted from chief engineer to vice-president in charge of engineering and planning.

DUNCAN G. HUDSON is now sales engineer for Chamberlain Laboratories, East Lansing, Mich. He was formerly project engineer for Continental Motors Corp., Detroit, where he worked on the design and production of experimental engineering.

Formerly detail and layout draftsman for Superior Engine Division, National Supply Co., Springfield, Ohio, **NICHOLAS W. ZELENEWYCH** is now layout design draftsman for International-Plainfield Motor Co., Plainfield, N. J.

MAJOR FRANK E. BLACK has been honorably discharged from the U. S. Army, where he was stationed at Fort Bliss, Tex. He is now associated with Continental Transportation Lines, Pittsburgh.

A. J. BATTEY has been appointed chief engineer of spark plug design and production for Auburn Spark Plug Co., Auburn,

A. J. Battey

N. Y. For the past 14 years he was experimental engineer in charge of design and development for AC Spark Plug Division, GMC, Flint, Mich.

Formerly assistant manager of the Aviation Division of Weatherhead Co., Cleveland, **LESTER J. HENDERSON** has been named assistant general sales manager of the company. He is chairman of SAE Aircraft Accessories & Equipment Subdivision's Committee A-3.

MILLER A. WACHS, who had been helicopter project engineer for Sikorsky Aircraft Division, United Aircraft Corp.,

Miller A. Wachs

Bridgeport, Conn., is now development engineer of the company.

WILLIAM E. WHEDON has joined Carney Engineering Co., New York City, industrial engineers, as engineer-in-charge.

FREDERICK C. CRAWFORD, president of Thompson Products, Inc., has been elected a trustee of Mutual Life Insurance Co. of N. Y. He is chairman of the National Association of Manufacturers, having served as its president in 1943.

RICHARD ARNOLD, formerly research engineer for Lubri-Zol Corp., Cleveland, is now employed by Columbia Electric Mfg. Co., same city, as production engineer.

RICHARD V. HICKS is now chief engineer of Fram Corp., East Providence, R. I. Previously an engineer for Adel Precision Products Corp., Burbank, Calif., Mr. Hicks joined Fram Corp. several months ago as assistant chief engineer.

VICTOR E. MATULAITIS, who had been electrical engineer for Chrysler Engineering Corp., Highland Park, Mich., is now with F. A. Smith Mfg. Co., Rochester, N. Y., in the same capacity.

K. D. WOOD, professor of aeronautical engineering, has moved from Purdue University, Lafayette, Ind., to the University of Colorado, Boulder, Colo.

George W. Dunham

GEORGE W. DUNHAM, one of the pioneers of the automobile industry as chief engineer of the Olds Motor Works, Hudson Motor Car Co., and Chalmers Motor Co., has again become a consultant after several years with General Electric Co., where he was responsible for the engineering of the product in the Home Laundry Division. Mr. Dunham, who was a president of the SAE in 1917, is opening offices at Westport, Conn., to make available a service for design and development specializing in domestic appliances.

HAROLD VICTOR BORDEAUX, formerly a planner in the experimental laboratory of Lockheed Aircraft Corp., Plant 1, Burbank, Calif., is now welding engineer in the Electrode Division, McKay Co., Los Angeles.

RICHARD W. WILSON, U. S. Army Air Forces, is an aviation cadet stationed at Randolph Field, Tex. Before entering the service he was test engineer for Buda Co., Harvey, Ill.

EDWIN R. CLARKE, formerly sales engineer for Haskelite Mfg. Corp., Grand Rapids, Mich., is now design engineer for Beech Aircraft Corp., Wichita, Kan.

OBITUARY

Hiram J. Halle

Hiram J. Halle, president of Universal Oil Products Co., died May 29 at the age of 77. Mr. Halle had been associated with the oil industry since 1914. He helped develop the process of "cracking" petroleum to produce gasoline and also contributed to the development of high-octane gasoline. After Hitler came to power in Germany, Mr. Halle joined a group led by Dr. Alvin Johnson in establishing the University in Exile, which bears the name of the Graduate Faculty of Political and Social Science of the New School for Social Research.

As a young man Mr. Halle was responsible for the development of the Fisher Book Typewriter, which became a component of the Elliott-Fisher Bookkeeping Machine. Later he invented the device for which the basic patent for the cross-totaling of adding machines was subsequently issued.

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Technical IDEAS for ENGINEERS

Study Arctic Operation of Aircraft Engines as Aid to Global Transport

by GEORGE A. BLEYLE
Wright Aeronautical Corp.

▪ **National Aeronautic Meeting**

(Excerpts from paper entitled "Cold Weather Operation of Aircraft")

THE problem of operating airplanes in the Arctic can be divided into airplane and powerplant problems. It is the latter we will discuss here.

Bush operators in northern regions usually drain oil from the lubricating system as soon as the engine is stopped, and then engine covers are installed. Low capacity heaters are then placed on the ground below the engine and inside the engine cover. If the airplane is on the ground only for a short time, the heater is kept going continuously; for extended periods on the ground, the powerplant is allowed to cool down. With a low capacity heater the warmup requires many hours. This system is satisfactory when used with small airplanes and a small number of airplanes in operation at one time. For large planes and for the basing of a large number of planes at one field such a procedure becomes cumbersome.

To start large airplanes in the Arctic either one of two methods can be used, both of which are outlined in Table I. The method using heat and gasoline for the priming fuel is being used today, but the preheating period that is necessary is a drawback. The system using no external heat to the engine is still in the development stage.

Aviation grade 1100 engine oil has been developed to the extent that when it has been mixed with aviation gasoline in the ratio of 70 parts of oil to 30 parts of gasoline, the oil is fluid at −60 F, and has an extrapolated Saybolt University viscosity of about 30,000 sec. This oil with warm batteries permitted the engine to be cranked at a reasonable speed at all temperatures.

Once this was done, the next problem was to develop a starting fuel and priming system that would make positive quick fire starts at all temperatures down to −65 F. It was found that starting sequence becomes irregular below 20 F; below 0 F it is practically imperative that a special priming fuel be used if quick consistent starts are to be accomplished without preheating the powerplant.

At −20 F when using 100 octane aviation fuel, 98% of the fuel delivered to the engine during the cranking period of a starting test was recovered in liquid form. Recovery was possible due to the construction of the Cyclone engine, in which there is a large cavity at the entrance of the supercharger impeller inlet. This cavity catches any fuel delivered by the priming nozzles, which are located in the carburetor adapter, and has not vaporized. Liquid fuel is drained overboard by the supercharger drain valve when the engine is not running. This type of priming and induction system has four advantages over intake valve port priming, which are (1) reduction of danger from hydraulic lock in the lower cylinders, (2) reduction of piston skuffing due to the washing of the lubricant from the cylinder walls, (3) danger from fire, and (4) fuel has a longer time to vaporize before coming in contact with metal parts.

TABLE I

Large Airplane Starting Method for Arctic Operation

If Temperature Never Goes Below	Priming Fuel	External Heat to Engine	Oil Dilution	Battery Heat
30F	(a) Gasoline	No	No	No
0F	(a) Gasoline	Yes	Yes, 10%	No, if fully charged
	(b) Special	No	Yes, 10%	No, if fully charged
−30F	(a) Gasoline	Yes	Yes, 20%	Yes
	(b) Special	No	Yes, 20%	Yes
−60F	(a) Gasoline	Yes	Yes, 30%	Yes
	(b) Special	No	Yes, 30%	Yes

High output aircraft engines have a high valve overlap due to which both the exhaust and inlet valves are open at the same time. With inlet valve port priming the fuel has a very small space in which to vaporize before it comes in contact with surrounding metal parts. Unvaporized fuel will run out of the exhaust port if the cylinder is located with the exhaust valve on the underside. This fuel then accumulates in the exhaust collector ring, and may be ignited by the firing of a few cylinders, resulting in a serious fire.

When priming nozzles are located in the carburetor adapter, priming fuel has considerable space in which to vaporize. Should the engine backfire during the starting cycle, any fire that may occur will be confined to the induction system, and it will be quickly extinguished by turning off the primer, opening the throttle wide, and continuing to crank the engine.

To determine what should be classified as a successful cold start the SAE Subcommittee E-16 on Cold Starting Requirements for Aircraft Engines has established the requirement that the engine should start within 32 sec cranking periods with a one minute rest period between the two cranking periods. Wright Aeronautical Corp. in conjunction with Standard Oil Development Co. therefore set out to develop a priming fuel that would meet these requirements:

1. It would be introduced to the engine through the present priming system.
2. Starting procedure would be the same as when starting with regular aviation fuel at normal temperatures.
3. It would give consistent sure-fire starts within SAE E-16 Committee's requirement for a successful cold start down to −65 F.
4. Vapor pressure of the fuel should be kept as low as possible so that its container weight would be kept to a minimum.
5. Weight of equipment added to the airplane would be kept to a minimum.

The first fuel tried was winter automotive gasoline, which gave excellent results down to −20 F. Isopentane gave satisfactory starts down to −40 F, but at −45 F starting became impossible. It was discovered that the minimum temperature which would permit a combustible mixture of isopentane and air was −65 F. Thus, unless a heat exchanger was used to vaporize the isopentane, −40 F was the limiting temperature. Blends of isopentane and normal butane were tried, and a 50-50 mixture of these gave good results at −50 F. Below this temperature the amount of butane required increased rapidly, and finally a start was made at −65 F on n-butane.

A blend was also developed which had a distillation curve similar to that of gasoline, but which fulfilled requirements between −65 F and +20 F. This was necessary because as the temperature decreased it became very diffult to obtain a flameable fuel-air ratio with a single substance fuel. Also, if only enough fuel was being supplied to maintain a combustible fuel/air ratio at cranking speed, the instant the engine fired the rush of air due to acceleration of the engine was enough to lean out the mixture so that the engine would cut out. Then, when sufficient fuel was supplied for idling, the mixture during cranking was then too rich to ignite.

Airplanes, I believe, can be made as independent of ground equipment as the present day automobile down to −20 F. Below that temperature the battery must be kept warm by some means of heat. Commercial winter automotive fuel can be used for priming the engine upon starting throughout a great portion of the operating areas, and a special starting gasoline will give satisfactory starts throughout the Arctic areas where the post-war intercontinent flights will pass.

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★ **Briefed from papers** ★

★ **given at** ★

★ **SAE MEETINGS** ★

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Automotive Engineers

Make Desert Tests Under Control in Dust Chamber

by R. P. FRENCH
Studebaker Corp.
▪ National War Materiel Meeting

(Excerpts from paper entitled "Experiments in Dust-Room Testing")

THE presence of dust in vehicle parts causes rapid wear and serious damage. In the attempt to develop protective devices for the exclusion of dust and dirt, a program was made from which test data could be obtained on vehicles operating in dust. While tests conducted in the field were successful, changeable climatic conditions presented some difficulty. Thus, it was decided to construct a laboratory where the climatic conditions had no effect, and where dust concentration could be controlled.

Test chamber:—This room, shown in Fig. 1, was 24 x 34 ft with a 20-ft ceiling and a total volume of 15,200 cu ft, equipped with dustroof lights which assist in making observations in dust clouds. Room temperature is controlled by regulating the engine cooling water temperature. Sixteen air jets are located in the floor to aid in dust agitation. These operate in conjunction with fans placed on the test vehicle wheels. Any desired dust concentration can be produced through the speed of the fans, the amount of dust deposit in the room, and periodic use of the air jets.

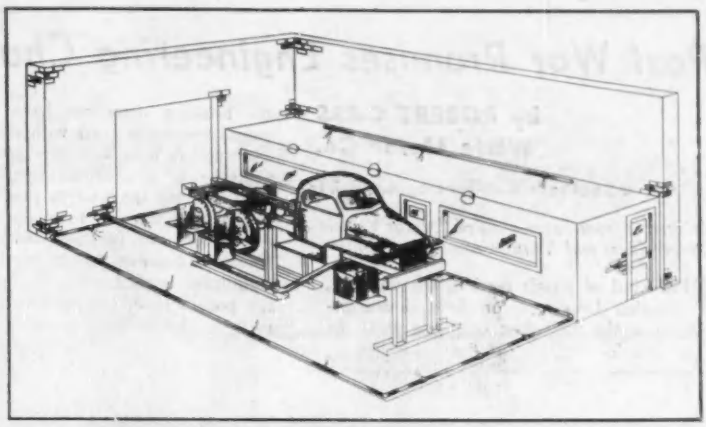
Observation room:—Operational control of the vehicle and test observations are made in this room, adjacent to and separated from the test chamber by a dust-tight partition 7 ft wide and 8 ft high.

Test procedure:—First tests were made with a two and a half-ton Army 6 x 6 truck chassis. The frame was mounted on five solidly braced stationary stands, affording a 10-in floor clearance under the wheels. Fans were mounted on each wheel to circulate the air. Those on the rear wheels consisted of four blades 18 in. wide and 40 in. across the ends. Front wheel fans were fastened to the wheel rim. These were smaller than the rear fans in order to permit full actuation of the steering cycle. In each steering cycle the front wheels were moved from hard right to hard left and back. As the air circulated, light dust particles were picked up from the floor to form the dust cloud for the test.

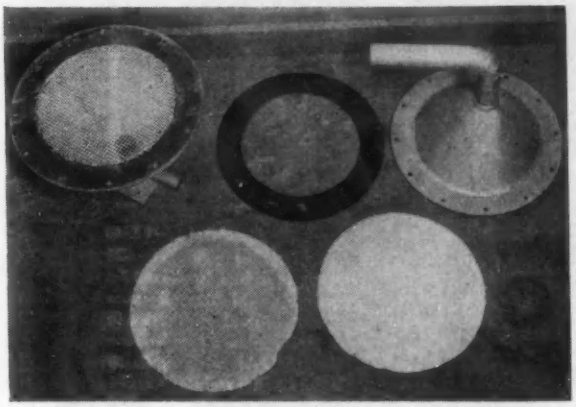
The engine drive line and wheels of the truck were driven at a speed of 30 mph for 5-min periods; then the clutch was disengaged and the wheels braked to a stop. A complete steering cycle was made every 5 min. Thus, all parts were in normal motion under dust conditions.

The operator controlled the dust concentration by use of air jets and recorded all operating conditions such as temperatures, oil pressure, and other necessary data. After 30 min of testing, he donned a dustproof suit and entered the chamber.

Dust used in the first test during which a truck was operated for 50 hr, was obtained south of Phoenix, Ariz., and possessed high abrasive properties and fine particle size. Of volcanic origin, it was analyzed as being 65% quartz. Dust used in the second test was obtained from sand-blast refuse and has about the same particle size as the Arizona dust.



▪ Fig. 1 (above) – Test chamber, 24 x 34 ft, 20-ft ceiling, total volume of 15,200 cu ft. Dimensions permit a 4 ft lateral clearance around any heavy-duty truck or light tank, giving ample space for circulation of dust



▪ Fig. 2 (left) – Absolute felt filter cloth supported between two metal hoods on which dust is held. Clean air is drawn through to be measured and discharged by the vacuum pump at the rate of 10 cu ft per min

Air samples were continuously drawn from the chamber during the test for measurement of dust concentration by means of an absolute filter, seen in Fig. 2.

Results:—Effects of dust leakage into parts showed the following:

1. Carburetor air cleaners were never operated beyond their dirt-holding capacity, thereby maintaining a high efficiency (about 99%). Even with a high efficiency air cleaner, considerable dust passed through it and produced serious engine wear. Dust deposits were found inside the carburetor and in the intake ports of the cylinder block.

2. Crankcase ventilation in the vehicle under test was a closed system. As such, air was taken from the intake line just below the carburetor air cleaner but above the throttle, through the crankcase and valve chamber, and into the intake manifold. Dust particles passing through the air cleaner either entered the crankcase ventilating system or passed into the engine through the intake.

3. Cylinder bore and piston rings had worn in 1000 miles of test an equivalent of 20,000 miles of ordinary road operation. Untreated cast iron piston rings were used.

4. Very little dust had collected around the oil dipstick or filler cap.

5. The generator and starter were heavily packed with dust.

6. While the clutch housing was filled with dust, the clutch, which was of the single-plate dry type, cleaned itself quite satisfactorily and showed no noticeable wear.

7. Ignition coils and high tension wires were covered with a heavy coating of dust which held moisture.

8. Brakes collected a large quantity of dust, although very little was found in wheel bearings. The duty on the brakes was not sufficient to produce much wear on the drums or lining.

9. Drive shaft splines and universal joints were covered with dust. Splines were worn, but no actual measurements to show the extent of wear were made.

10. All felt seals were loaded with dust. Seals around the flanges and rotating parts carried heavy ring formations of dust which were held next to the seal by the oil seepage. Leather of the seals indicated wear, but not enough to allow excessive leakage during the short length of this test.

11. Examination of the truck cab, upon completion of the test, showed all surfaces inside the cab covered with a ¼-in. deposit of dust. Doors and windows were closed during the tests.

12. Samples of oil were taken after the 50-hr test and centrifuged for their dust content. Results were as follows:

	% Sediment by Volume
Engine	1.0
Transmission	2.8
Transfer case	3.8
Front differential	2.0
Forward rear differential	2.0
Rear differential	1.5

13. Dust was taken into the axles and cases through the breathers.

Results of the dust chamber thus far indicate that the room can be used in performing qualitative accelerated tests on vehicles subjected to excessive damage from the operation in dust. In addition to the potentialities of evaluating mechanical designs, it is believed that the test chamber may also serve a purpose in reducing discomfort from the leakage of dust into the passenger compartment.

Post War Promises Engineering Changes

by ROBERT CASS
White Motor Co.

▪ Southern California, April 28

(Excerpts from paper entitled "Motor Vehicle Powerplants and Transmission Line Units")

THE kind of power used in the post-war, whether Otto cycle or diesel, bears discussion as the fuel plays only one part. In the broadest sense, we have two fuels to consider—fuel as used with the diesel cycle, and fuel as used with the gasoline engine. Considering diesel fuels, there seems to be no doubt that the catalytic processes, initiated during the war to a greater degree than ever before, will be continued in the future. Newer equipment will be used and the old equipment written off. We may then face the possibility of having the best diesel oils used in the catalytic process for manufacturing aviation gasoline, and also having the catalytic-processed diesel fuel come out initially with a low cetane number for diesel engines. This will mean doctoring the fuel with additives to improve the ignition point, and we may have the problem of engine deposits accentuated by this change in refining processes.

Regarding fuel for gasoline engines, the catalytic processes which seem to be unfavorable to diesel fuels unquestionably help to secure higher octane fuels without any appreciable cost by virtue of the process itself. It may be that the gasoline engine for high output per cubic inch and for large gross horsepower outputs will be designed for premium grade fuels. We may also have engines in the gasoline field in which our output per cubic inch could be increased as much as 25%, by means of compression ratio changes, among other ways.

The type of gasoline engine which seems best suited to take advantage of fuel improvements is the "L" head—which, at the start of the war, when we had gasoline of around 77 octane, would haul 1000 or 10,000 lb of payload as cheap, or cheaper, in ton miles per gallon, as any other type of gasoline engine. For the immediate future, there is no reason to discard the basic unit of integral crankcase and block design associated with this type.

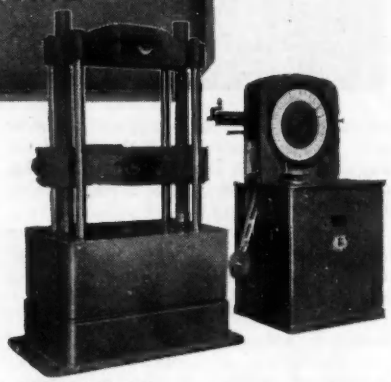
In post-war engine design, the aircooled engine deserves consideration. The amazing performance that has been secured in output in aircraft aircooled engines is along the line of development that we hope for in truck engines. An engine that produces a horsepower per cubic inch as a practicable possibility would be invaluable in our vehicles. The main difficulty in the truck field, however, is in the control of overall engine temperature. No way has yet been developed that will, from a cost standpoint, permit consideration of automatic control of engine temperatures. Weight saving and reduction of engine parts are partially compensating factors, but not enough to outweigh the disadvantages that come with lack of temperature control. Also, solution of the cab heating problem is not easily possible.

The bearing picture in the post-war engine is of great importance. Plated silver bearings seem to be offering the great promise in connection with load carrying rating, but their cost of production is very high. However, since they permit extended life of the crankshaft, it is hoped that these bearings can be used for mileages greatly in excess of what is now accepted as reasonable. Silver bearings will not be discarded if they give the same per mile cost as copper-lead. The expected type will be steel-backed with perhaps 0.015 of copper lead finely divided and a final plating of 0.0005—or a trimetal type.

The future of aluminum also presents difficulties. While its weight-saving possibilities are favorable, its expansion characteristics are such as to call for very accurate appreciation of what happens to an engine under hard working conditions. We know that alloy cast iron, commonly used in cylinder blocks and crankcases, can take a continuous beating both from a heat and load standpoint. Aluminum has not always been as stable, and seems more sensitive to fatigue than iron. Therefore, development of fully aluminum engines will be very gradual.

There is a logical place for the supercharger in the truck field only if it is based

"One test is worth a thousand expert opinions"
- The Riehle Axiom



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on the sound economic basis that it can be applied to an engine of lower weight per horsepower and reduced price per horsepower, and yet still give engine life within reasonable expectancy. So far, these qualities have not been combined.

Post-war use of automatic transmissions will be a must in the bus field, but the element of cost enters largely in its use in the truck field. Basic requirements for automatic transmissions are:

1. Elimination of manual operation of the clutch and gear shift lever.
2. If gear steps are retained, shifting should take place automatically at the correct time under all conditions.
3. The engine must be available for braking.
4. The driver should have a certain amount of overruling power, which should not require any buttons or levers.
5. Transmission should be simple, and no special service problems should arise.

These conditions can be satisfied by (1) mechanical automatic transmission, including automatic friction clutch; (2) hydraulic coupling plus automatic mechanical transmission with or without automatic friction clutch; (3) hydraulic torque converter with or without auxiliary automatic transmission.

For buses or trucks where clutch wear has been an important service problem, it would be desirable to eliminate the friction clutch entirely. This could be done by adopting hydraulic coupling with an automatic transmission. However, the best method of eliminating or reducing gear steps, and thereby simplifying controls, is offered by the hydraulic torque converter.

Axles and brakes are equally important from the standpoint of future trends. In designs of axles, aluminum should play a big part if there is sufficient interest on the part of the truck operator to evaluate where the increased revenue can come from the increased cost of his overall axle setup. Regarding brakes, much work must yet be done to achieve the ultimate of safety and control of large train loads.

1944 Tire Output Picture Confused But Not Hopeless

by F. W. DARBRO
General Tire & Rubber Co.

▪ **Southern Ohio, Nov. 19**

(Excerpts from paper entitled "Truck Tires")

WILL our highway transportation system collapse? There are some who will say this question is absurd and silly. Let us look at 1944 conditions and judge.

Our requirements this year are military, 10 million truck tires, air forces, 1½ million large tires, and civilian, 7 million truck tires, making a total of 18½ million. Our peak production in this country was 12 million truck tires per year. Now the most optimistic in the rubber business don't believe we can produce more than 14 million. If our requirements are 18½ million, we can produce only 14 million, and some doubt if we can reach the 12 million figure.

• No "magic wands" or "cure-alls" are at the command of the Stuart service engineer. For a wand he uses the fund of engineering experience developed by D. A. Stuart Oil Co. over 79 years in the business. Instead of cure-alls, he offers top quality cutting fluids engineered to job requirements. With these simple tools he has achieved results in metal-working far more useful than the best that magic can boast. With your cooperation, we feel confident that he can do the same for you.

Our free booklet called "The 577th Oil" gets down to cases. Write for your copy.

For All Cutting Fluid Problems
D. A. STUART OIL CO.
Chicago, U.S.A. • LIMITED • Est. 1865
Warehouses in All Principal Metal Working Centers

Let's see what our limits are in getting 14 million. Synthetic rubber has reduced production between 20 and 30%. Also, although production of tires is just as important as other fighting equipment, the draft has taken its toll of good mechanics. Then, there is a fabric shortage of cotton and rayon. Finally, there is a general slowdown not only in the rubber industry, but in industry all over the United States.

The tires we get next year are not going to be as good as we have been accustomed to using. They will be synthetic rubber, and the cold facts are that we have not learned yet how to make a good truck tire out of rubber substitute. Our 4 and 6 ply tires have been doing a normal rubber tire job. The 8 ply is doing from a 75 to 90% job. The 10, 12, and 14 ply tires are not doing a very good job. Aside from the fact that we must begin using tires of synthetic rubber, due to our small crude rubber stockpile, there are other musts that we have to start immediately. We must use these tires so as to eliminate overload. We must keep our tires properly inflated. We must keep correct pressure on the tires all the time. We must keep dual tires properly mated, because mismating gives 100% overload at times. We must use great care in mounting tires with synthetic tubes.

These tires will be purchased from the rubber companies on an as is, for better or worse, basis. The Government is not going to permit any policy of adjustment. There will be a central truck inspection station in Cincinnati, as quickly as it can be organized, as well as many more all over the country. Before a buyer can get new tires, he must go to the central station, and if the tire shows abuse, whether accidental or otherwise, he will not be issued a certificate. I would like to sell two ideas. Those old rubber carcasses in your possession are among the most important things you have, and before another year will have passed, they must be treaded again and again.

BORG & BECK

The Standard Clutch in Peace or War!

BORG & BECK DIVISION
BORG-WARNER CORPORATION
CHICAGO ILLINOIS

Nation's Rubber Future Bright

by F. B. DAVIS, JR.
U. S. Rubber Co.

Detroit, April 3

(Excerpts from paper entitled "The Future of Synthetic Rubber")

THE war machine has left little in the way of rubber products for the average citizen. Essential replacement requirements for passenger-car tires this year were estimated as not less than 30 million. Due to demands for other war products and the shortage of manpower, it was evident that the industry could not make more than 22 million.

The industry will have produced only about seven million passenger tires in the first six months of this year. To reach the 22 million, the industry will have to turn out 15 million passenger tires in the last six months of this year. Whether we can do this or not depends wholly on the course of the war.

In anticipation of the critical tire situation, the rubber industry last summer laid plans for the execution of an expansion program as rapidly as the shifting needs of war would permit. Some plants which had been converted to the making of ammunition are being reconverted to tire manufacture. In other plants, additional tire building equipment is being installed as fast as it can be obtained.

As a further means of helping conditions, enough camelback for the retreading industry is now being produced to recap 25 million passenger-car tires and six million truck and bus tires.

The situation with regard to truck and bus tires is more serious than in the passenger tire field. Their construction requires rayon cord, of which there is a drastic shortage.

The type of synthetic rubber used in both passenger-car and truck and bus tires is buna S, also known as GR-S, which is more like natural rubber than any other synthetic, and which can be produced in large quantities. Today, passenger-car tires of 100% buna S are satisfactory.

Medium-heavy service truck and bus tires still need some natural rubber. The amount has been gradually reduced until, in most cases, we now use only 10% natural with the synthetic to make a satisfactory tire.

In large-size heavy-duty truck and bus tires the amount of natural rubber required, even when used with rayon cord, runs as high as 65%.

A new degree of efficiency in the use of natural rubber is made possible by a newly developed method of construction, which places natural rubber at the point where it is most needed – in the carcass directly under the tread where the greatest heat is built up. Synthetic rubber is used throughout the rest of the carcass and in the tread.

This type of construction, known as the "inlaid carcass," substantially improves performance. Tests show that where the same amount of rubber is used, the new carcass outperforms the conventional type. Where rayon cord is used, the inlaid carcass is as good as the pre-war natural rubber cotton type.

Much has been said concerning the cost of making buna S. The Rubber Director has stated that since butadiene can be made from petroleum at seven cents a pound, buna S will cost 13¢, including amortizing charges. Is this 13¢ buna S going to be able to compete with natural rubber?

If, at the end of the war, there has been little damage to areas now held by the Japanese, total potential production of natural rubber for the world should be about 1,700,000 tons. Due to neglect, disease, and jungle growth, output of the average plantation will be reduced by 30%. A great deal of re-equipping, clearing out of undergrowth, rebuilding of roads and drains will have to be undertaken, which will consume time and money.

We have estimated world production of 500,000 tons during the first year after possession of the territory is regained, followed by a gradual increase to a maximum of 1,200,000 – provided that the price for rubber is adequate to induce the reopening of all areas. What that price is will depend on the relationship of supply and demand.

Restoration of wartorn areas will call for increased quantities of rubber. Our own needs for tires and tubes will be enormous. Yearly replacement needs alone have been estimated at 50 million tires a year for the first two years after the war, to which must be added the number required for whatever new cars the automotive industry produces.

Thus, indications are that for the first year after the war there will be a need for all synthetic plus all the natural rubber which can be made available at a reasonable price – a quantity of about 1,200,000 tons.

In the near future we may have available more rubber than we can process. Even under adverse conditions, however, there will be a need for the output of a majority of synthetic rubber plants for several years after the war. These plants will provide military security and insure us against unreasonable prices for the natural product.

The possibility of higher prices for the natural product should not be overlooked. Among the reasons are increased wages in the East Indies, continued restriction on crude production, or a subsidy for synthetic. The most important factor of all determining the future price of imported rubber will be the value of the American dollar in terms of the basic living needs of the Eastern coolie. To what extent synthetic will fit into this picture will depend on what improvement in quality and performance is attained during the next few years.

It would not be surprising if, with the tremendous impetus which has been given to research in this field, we do not succeed in producing tires and other major products from synthetic rubber the equal of natural and at a competitive price.

Design Principles Similar for Land and Air Engines

by COL. JESSE G. VINCENT
Packard Motor Car Co.

a National Aeronautic Meeting

(Excerpts from paper entitled "Aircraft Engine Production as Viewed by an Automobile Manufacturer")

THE problems in design, development and production of both automobile and aircraft engines are very similar. The differences are largely a matter of degree. For instance, production cost and manufacturing complexities of some aircraft parts are shocking to the automobile designer, but the difference in viewpoint ends there. Manufacturing to close tolerances and production of closely controlled finishes is nothing new to the automobile manufacturer, for he has learned to require these things as a matter of manufacturing c[redacted]

Packard's assignm[redacted] 1940 to produce

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ERIE "L-7" Suppressors are designed to fit both spark plugs and distributors. The two rings formed in the metal terminal of Type L-7 Suppressors make pressure contact with the metal insert in the distributor cap, providing a firm electrical connection. Snap-pressure contact with the spark plugs and wood screw connection to the cable are vibration proof.

This feature of "universal application" permits standardization of suppressor equipment, thereby simplifying purchasing and parts stocking problems.

The efficiency and long functional life of Erie Suppressors is attested to by the fact that they stand up under the severest laboratory tests, as well as the rigorous service demands of mobile military equipment. A data sheet giving full information on Erie Suppressors will be sent upon request.

Let's All Back The Attack
BUY WAR BONDS

ERIE RESISTOR CORP., ERIE, PA. TORONTO, CANADA LONDON, ENGLAND
PIONEER MANUFACTURER OF IGNITION SUPPRESSORS

9000 Rolls Royce Merlin engines for the Army Air Forces – 3000 for our country and 6000 for the British – presented several problems. The first job was to prepare drawings from which to build the engine. It was necessary to adapt the British drawing to American nomenclature and methods. It was essential to establish specifications for the finish of all parts and place these upon drawings. Sample-made British parts were checked with a profilometer and the resulting readings of finish smoothness specified on the drawings.

This redrawing occupied some 75 men for about four months, and 2500 drawings were so prepared. About 50 prints of each drawing were required for estimating and manufacturing, making 125,000 blueprints issued.

There was no attempt to change or accomplish supposed improvements in British design. The major changes were the substitution of an American-designed and built carburetor for the British carburetor formerly used. The controls, however, were identical, and it was required in our specifications that the Packard-built engine be absolutely interchangeable with the British engine in any airplane.

After the first drawings were released to the manufacturing division, then a processing routine was set up and tools designed.

There were 1978 different parts in the engine, excluding the carburetor, boost control, magnetos and ignition harness – which were purchased outside. For Packard production, it was necessary to design and construct more than 60,000 gages, tools and fixtures.

The manufacture of these parts in the quantities required for the schedule set up for the first production contract called for some 3575 machine tools, for aircraft engines, on the whole, cannot be produced with the machine tools formerly used for the manufacture of automobiles.

In setting up assembly operations, we tended toward the continuous productoin line in which continuous subassembly lines feed transversely into a main production line, power-operated and ending at the test stand. The value of engines coming off the Packard Rolls-Royce final assembly lines is approximately $1000 per min.

Another use of the continuous assembly line is in the tear-down and rebuild of the engines after the production "green run." After removal from the engine test stand, the engine is washed and started on a U-shaped disassembly and rebuild line. The first part to be removed is the ignition harness. This is passed across from one end of the U to the other, during which time it is cleaned, inspected, and meets the same engine from which it was removed at the other end of the line. There it is the last part to be assembled to the engine. In a like manner, other parts and assemblies are passed cross the U, the transverse lines being staffed with as many disassemblers, inspectors and assemblers as is necessary to complete the operations on the particular subassembly for which the transverse line is set up. The crankcase passes around the closed end of the U, where it is washed and inspected and then receives the inspected parts and subassemblies as it passes up the assembly side of the line.

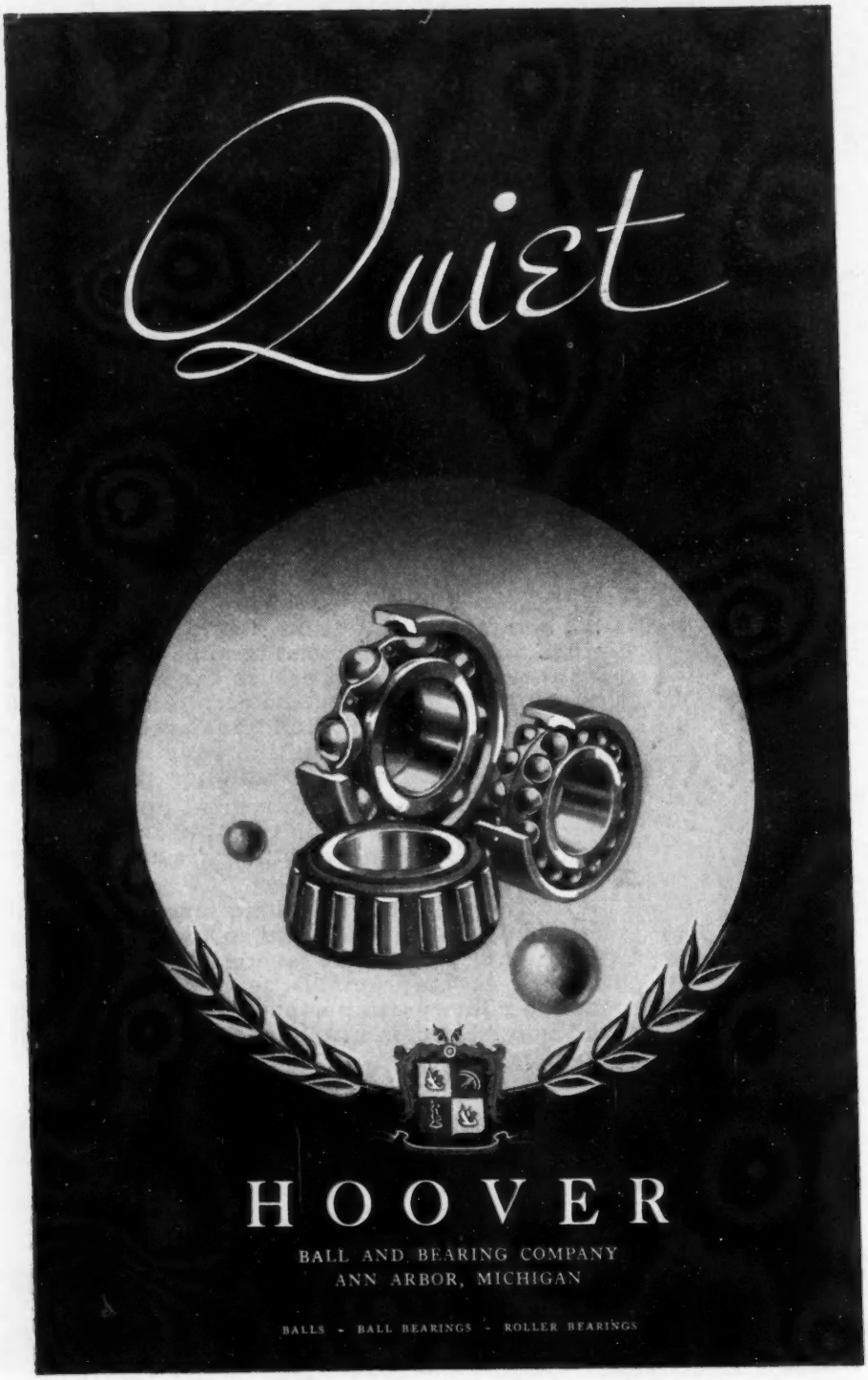
This method of tear-down and reassembly greatly reduces occupancy of floor space for these operations, but the primary advantage is that it greatly expedites training of "green" personnel in the functional requirements of one operation.

In the setting up of suitable production testing facilities, it has been necessary to establish experimental development departments for the conducting of proof tests on engine model changes, verification and correction of engine service difficulties, and to develop improvements in existing designs.

One of the most important differences between automobile and aircraft engine production is the introduction of the voice of our customer-Governments into the engineering, production and testing of the product.

DISCUSSION

When Col. Vincent was asked how parts are identified when traveling across the U in the disassembly line, he replied that they are kept in tagged boxes which are timed to arrive at the far side of the U when they are needed. To effect correct timing, a wooden mockup of the engine was made, he declared, and disassembled a number of times on the line to arrive at an accurate estimate of the time involved. The line now handles twice the number of engines first estimated as full capacity, he disclosed.



APPLICATIONS Received

The applications for membership received between June 10, 1944, and July 10, 1944, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section: Austin Leroy Reynolds.

Buffalo Section: James W. Boyd.

Canadian Section: Frederick G. Adams, Edgar J. Bradbury, Leonard Mills, Kenneth L. Morris.

Chicago Section: Hosmer H. Allyn.

Cleveland Section: William B. Buckman, John Czernecki, Emery G. Gilson, Paul R. Guerin, Donald A. Hendricks, Stuart C. Plummer, W. J. Raleigh, Theron T. Thompson.

Detroit Section: Bowling Green Rubber Co., William H. Demerah, Robert H. Malcolm, H. R. Eshleman, Grover C. Farnsworth, James W. Greig, Glenn H. Hicks, Lorin B. Kruse, Warren M. Merrill, Harold D. Morehouse, Roy C. Penrod, Frank W. Rising, Clyde L. Ryan, H. R. Smith, Jr., John C. Sterritt, Frederick Charles Longley Stokes, George E. Stoll, Louis B. Taylor.

Indiana Section: Philip B. Lovett, Norman L. Woolley.

Kansas City Section: Charles A. Ashbaugh, John A. Fischer.

Metropolitan Section: Clark R. Bennett, Charles E. Conover, H. G. Denham, Howard J. Diehl, Augustin Dilworth, Louis H. Enos, John Gitz, J. E. Hardy, Motor Haulage Co., Inc., Joseph D. Roughgarden, II, Emil B. Sanders, Oscar F. Soetbeer, Alfred Sonntag, Charles Carroll Sons, Jr., James George Turton, Edward F. Wohlers, Sr.

Milwaukee Section: Louis D. Caron, Jr., Austin Gudmundsen, Fred A. Loebel, J. V. Resek, Gerald Robechaud, John L. Ryde.

Mohawk-Hudson Group: Edward G. Haven.

New England Section: Nicholas Grossman.

Northern California Section: Frederick Maxwell Ball, Jack Guy Mencaccy.

Northwest Section: W. Anthony Arntson.

Oregon Section: E. A. Littrell, R. B. Reynolds, Earl Bert Richardson.

Philadelphia Section: Brent C. Jacob, Jr., George J. Murphy, James Myhre, Herbert Arthur Pett'.

St. Louis Section: C. B. Fites, Steven Schnell, William S. Wilson.

Southern California Section: William Argyle Clegern, Garrett H. Edgell, Charles E. Gaugh, Walter L. Goodman, Lee M. Hutchins, Henry M. Livran, Major Charles W. Mills, Jr., Ross Nichols, George A. Powell, Harry S. Richter, Frank Benjamin Tipton, Orville L. Wilkinson.

Southern Ohio Section: H. Yale Mageoch, Frank M. Mallett.

Southern New England Section: Allan R. Armstrong, George F. Hagger, Carl Frederick Johnson, Jr., J. D. Lostritto.

Syracuse Section: A. A. Bradd, Thomas B. Frame, Theodore A. LaBrecque.

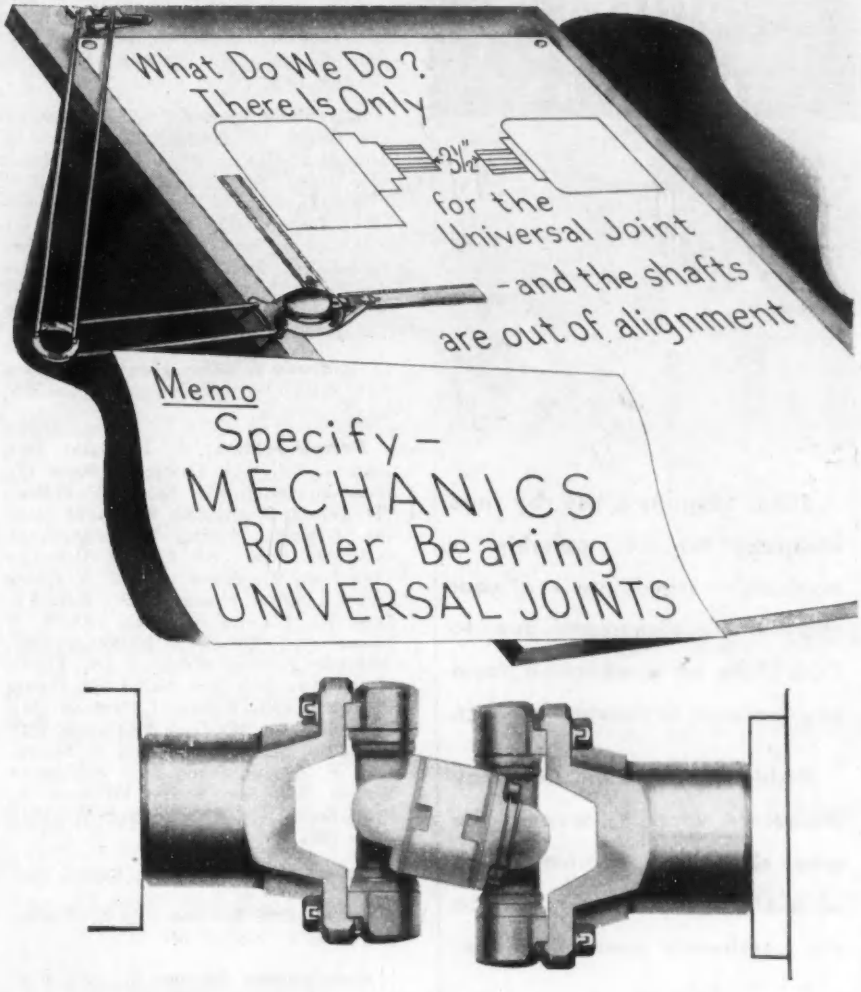
Texas Section: Otto August Genzel, Jr., Smith Lee Miller, William Mitchell Rice, Edward L. Stacey, Tony G. Whitener.

Twin City Group: David M. Little.

Washington Section: Seymour J. Deitchman, Kenneth W. Elvin, C. Bedell Monro, C. Austin Sutherland.

Outside of Section Territory: Harold Gustav Johnson, Everett J. Neuteboom, Byron R. Pool, James Frederick Smith.

Foreign: Robert Marcus, Palestine; Janos Molnar, Australia; Keith McKenzie Stearne, Australia; Norman Arthur White, England.



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Borg-Warner Corporation
2020 Harrison Avenue, Rockford, Ill. Detroit Office, 7-234 G. M. Bldg.

NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between June 10, 1944, and July 10, 1944.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section: Capt. J. A. Hutchinson, Jr. (J), Lt. Albert V. Zimmerman (S M).

Buffalo Section: J. A. Lux (M).

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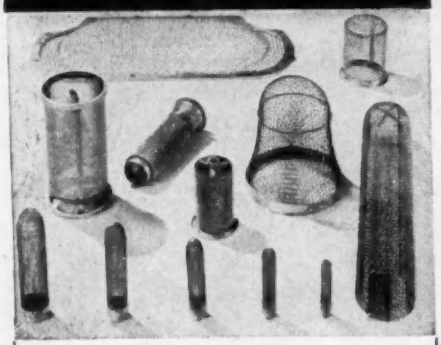

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Canadian Section: Robert Thomas Blackmore (M), Robert B. McIntyre (M), David Dunseath McMillan (A), Alfred Hugh Paton (M), James H. Thomson (A).

Chicago Section: Robert E. Allen (A), Robert G. Brooks (A), Sal Colacuori (M), Ralph R. Gunderson (M), Robert G. Moyer (J), J. A. Reinhardt (M), Henry W. Saly (M), Clarence W. Wandrey (M), C. S. Winston (M).

Cleveland Section: William Emmerson Berkey (J), Edward K. Brown (A), Morgan P. Hanson (J), Robert L. Johnson (J), Ernest B. Mansfield (M), Floyd Y. Miller (J), Bruce H. Multhaup (J), J. Frederick Norton (J), Herman Palter (J), Preben John Peterson (M), James Gilbert Ruspino (J), David W. Scott (A), Fred Van Arsdell (J), John A. Vaughan (A), Richard F. Warner (J), Jerold L. Welch (J), E. R. Young (A).

Colorado Group: Oscar Guy Byers (A), Walter W. Carlson (A), Lt. Louis A. Edelman (S M).

Detroit Section: S. F. Baker (M), John A. Ball (A), George F. Bunte (J), Oscar B. Chapin (A), Robert W. Colburn (J), Thomas Couper (A), William M. Dawe (J), Frederick William Fleischhauer (J), Walter G. Freer (A), Curt H. Garmager (M), Louis R. Gelfand (M), N. A. Gibson (A), Clarence R. Hoofnagle (A), Ronald L. Loup (J), Clarence R. Makin (A), E. F. Mayne (A), Taine G. McDougal (M), Alexander Nicholas Melnichuk (A), Claude M. Metelski (A), John Najjar (J), George P. Pajares (A), William J. Parducci (M), Irving L. Ross (M), Glen Alan Smith (M), Gerald W. Stanke (J), Harold M. Stephen (M), F. A. Von Schon (A), William O. Watson (M), Sam Barlow Williams (J), Peter Zerhan, Jr. (J), Edward W. Zingsheim (M).

Indiana Section: John L. Buehler (M).

Kansas City Section: T. A. Bradley (A), John F. Pahl (S M).

Metropolitan Section: George S. Armstrong (M), Edward Alan Cohn (A), Lawrence Lyon Goldsmith (A), Raymond E. Hall (M), Edward Kirtland Hine (J), James Woodward Lewis (J), Edward R. Lindeke, Jr. (S M), Arthur B. Marsh (M), Joseph Mason, Jr. (J), James G. McIntosh (M), Peter James McLaren (M), George C. Miller (M), Arthur Dunn Nordhem (J), Alan E. Park (J), Melvin Pine (A), Fred R. Pinter (A), John F. Riley (J), Dr. A. A. Somerville (M), Alfred Bertin Steinau (A), Dr. Shou Chin Wang (M), Yu-Ching Wang (J), Daniel C. Wendel (A).

Mid-Continent Section: G. L. Wheatley (M).

Milwaukee Section: John Anglim (M).

Mohawk-Hudson Group: Joseph R. Harkness (M), George R. Sawin, Jr. (A).

New England Section: Earle F. Baker (A).

Northern California Section: Frank Woodward Commins (A), Walter Ambrose Hunting (A), Charles V. Johnson (A).

Northwest Section: Ivan Edward Lundstrom (A), Edward H. Williams (A).

Oregon Section: John L. Hall (A), Harry Robert Ward (A), Robert J. Wilhelm (A).

Philadelphia Section: William Randolph Berry (J), Charles Alfred Burton (A), James Jeffery (A), Andrew M. Maxwell (J), Paul L. Shuman (A).

Pittsburgh Section: Merlyn Joseph Patrick (M).

St. Louis Section: Murty R. Callahan (A).

Southern California Section: Orrin R. Broberg (M), Everitt A. Carter (J), Alvin Ernest Shumate (A), Roger Spicer Shute (M), Victor A. Smith (M), Herbert L. Trautmann (M), Theodore A. Woolsey (M).

Southern New England Section: Chester Hilton Cooper (A), Richard Danforth (J), Everett H. Kandarian (J), F. M. Morency (J), Oren F. Parker (A), Anthony Vincent Pond (J).

Southern Ohio Section: George V. Altermatt (S M), Joseph W. Brown (M), Walter M. Davies (M), Ralph Joseph Van Paepeghem (J).

Spokane Group: Carna Marcus Kimberlin (A).

Syracuse Section: Frank E. Cordone (M), James A. Robbins (J).

Texas Section: William Farnsworth Orr (A).

Twin City Group: Richard L. Acton (A), Robert M. L. Lindquist (J), Robert J. Lunn (J).

Washington Section: James Gunn Goodwillie, II (A), Fl. Lt. Douglas Gordon Moffitt (M), Capt. Turner Grafton Timberlake (S M).

Western Michigan Section: Arnold G. Anderson (A), Harry P. Bitzer (M), Carl E. Burke (J), H. Leslie Casselman (M), Albert W. Demmler (M), Herbert M. Shuman (M), Marion Cole Travis (A), Marvin A. Ziehms (M).

Wichita Section: M. L. Carter (A).

Outside of Section Territory: Carroll D. Fruth (J), Peter Joseph (A), C. V. Lisle (A), Jan R. Major (A), Motor Coach Industries, Ltd. (Aff.) Rep.: H. Zoltok. Harry S. Pack, Jr. (A.), William F. Ritcheske, Jr. (J), Albert Gallus Ruegg (A), B. F. South (M), 1st Lt. Vernon D. Young (A).

Foreign Henry Ward Allison (J), (New Zealand), Leslie Lewis Dyer (F M), (England), Edmund Giffen (F M), (England), Roderick Athelstane Keir (F M), (New Zealand), Lt.-Col. Richard Hector Quinnell (F M), (Egypt), A. W. Vickers (F M), (England).